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# AIR & SPACE

Smithsonian

December 2000/January 2001  
Volume 15 • Number 5

## FEATURES

### 26 Memories of Kosovo by Jonathan Knaul

*Though his mission is called "peacekeeping," a young helicopter pilot learns that there is still a war going on.*

### 34 Beat Up and Beautiful by John Fleischman

*Photographs by Eric Long and Mark Avino*

*These unrestored aircraft wear their histories on their sleeves.*

### 42 Test Drivers by D.C. Agle

*Every airplane has to take that one final exam. Here are the guys who give it.*

### 50 How to Get Along in Space by Beth Dickey

*Illustrations by David Povilaitis*

*On the International Space Station, your crewmates can hear you scream.*

### 56 Commentary: Why Airline Crashes Aren't Criminal

*by Kenneth P. Quinn*

*And why prosecution could hinder prevention.*

### 58 Soaring on Silk by Tom Harpole

*Photographs by Phil Schofield*

*What 4,000 U.S. paragliders know about freedom and risk.*

### 66 Hang a Right at Jupiter by Michael Milstein

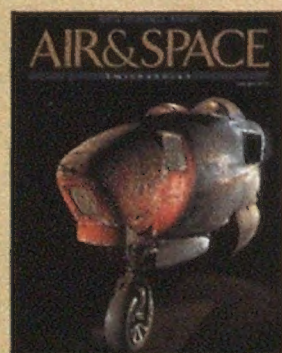
*To get where you're going in the solar system, you have to know where you've been.*

### 72 Home Grown by Nan Chase

*Ask the residents of Columbia, Missouri: You can't keep a good airline down.*

### 78 The Christmas Bombing by Marshall Michel

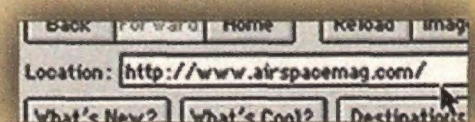
*The last U.S. battle of the Vietnam War was a tragic and controversial testing ground for B-52 crews.*



*Cover: With two bug-eyed cockpits and a plywood cone for a nose, the XB-43—the first U.S. jet bomber—hid in a warehouse corner till Eric Long and Mark Avino brought it to light.*

## DEPARTMENTS

- |    |                          |    |                      |
|----|--------------------------|----|----------------------|
| 4  | Viewport                 | 88 | Sightings            |
| 8  | Letters                  | 90 | Reviews & Previews   |
| 14 | Soundings                | 93 | Credits              |
| 20 | In the Museum            | 94 | Calendar             |
| 22 | Above & Beyond           | 95 | On the Web Site      |
| 24 | Flights & Fancy          | 95 | Forecast             |
| 41 | The Smithsonian Traveler | 96 | Moments & Milestones |







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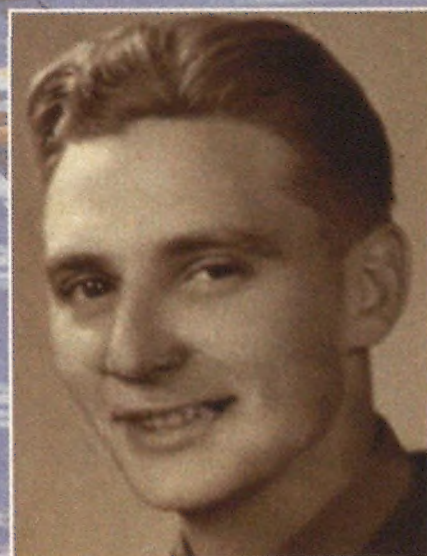
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## The Rest of the Iceberg

In the course of serving almost a year as director, I have learned a lot about some of the extraordinary activities in this Museum and how they fit our three primary responsibilities: to commemorate, to educate, and to inspire. Every day as I walk in the door I see evidence that these responsibilities are being met, from the display of the collection to educational events, such as our evening lectures.

Everyone is aware of our collection and its impact on visitors, but not as much is known about the scholarly research we support. This research adds to the value of the collection and ranges from hands-on studies of the materials and components used to build air- and spacecraft to library and archive searches that reveal the societal aspects of aviation and spaceflight. The work of our own staff is enriched immeasurably by the contributions of those who fill our research chairs and fellowships.

We host the Lindbergh Chair in Aerospace History, the Ramsey Fellowship in Naval Aviation, the Verville Fellowship for aerospace history, as well as competitive historical and scientific fellowships supported by the Daniel and Florence Guggenheim Foundation, the Smithsonian Institution, and research grants to individual staff members. We provide the facilities to conduct research on subjects of mutual interest, and, as a result, exceptional contributions have accrued, producing benefits for both the Museum and the scholars.

Past holders of chairs have included historians David Lewis, Williamson Murray, and Ron Davies, geophysicist James Van Allen, turbojet inventor Hans Von Ohain, and the late Donald Engen,

my predecessor as Museum director. Alfred Verville, who began his career helping Glenn Curtiss design the Jenny in 1914 and for whom the fellowship is named, was a fellow of the National Air Museum (our progenitor) in 1962. In this issue, an article by Marshall Michel, "The Christmas Bombing," is based in part on work he did here during the time he held a Verville Fellowship.

Nominations and selections of fellows are made through a peer review process and are very competitive. Members of the Museum staff do not dictate the results of research but often provide assistance and advice and, in the case of our younger fellows, can offer a valuable mentoring experience. Washington is a museum-rich environment, and researchers have access not only to the Museum's unmatched archives and staff but often to some priceless object that may have played a pivotal role in the area of their interest.

The payoff from scholarly research at the Museum extends beyond the explanatory labels that accompany artifacts. Like the artifacts and displays, labels are only the tip of the iceberg. The work of the fellowship program takes the form of books, monographs, and articles in professional literature. Quite often the results of research bring to light pieces of history that have been overlooked.

We play a clever game here: The chairs and fellows think they are the beneficiaries, but I would argue that in the end, the history and science of aviation and space are the winners.

—J. R. Dailey is the director of the National Air and Space Museum.

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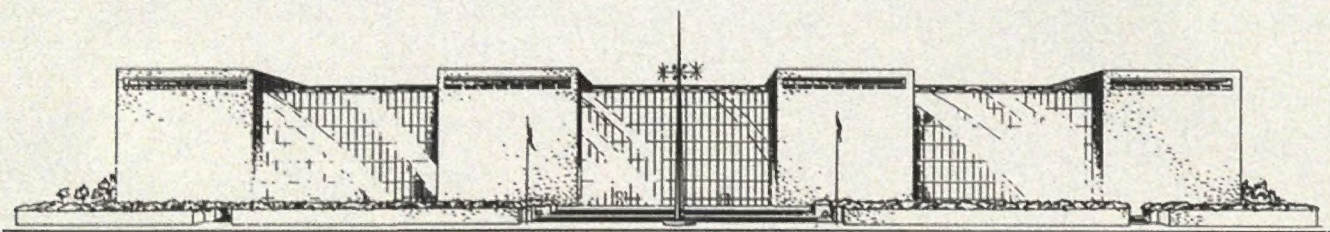
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## LETTERS

### P-40 Afterlife

"Big Finish" (Oct./Nov. 2000) brought to mind a book, published in 1961, titled *But Not in Shame*, by John Toland. Re-reading it some 20 years later, I noticed a passage recounting how the USS *Seawitch* dumped 27 crated P-40s into the bay at Tjilatjap, Java, on March 1, 1942. Now if somebody has a few million for an underwater search...

—Ron Smart  
North Golden Valley, Minnesota

Your article states several times that the Flying Tigers used P-40s against Japanese forces prior to the Pearl Harbor attack. That is not correct. The first action of the American Volunteer Group was against Japanese air force planes raiding Kunming, China, on December 20, 1941, and against Japanese planes over Rangoon, Burma, on December 23, 1941. The AVG did not even form into squadrons until November 1941, after arriving in British-controlled Burma in September for training. U.S. Army Air Forces pilots in Hawaii and in the Philippines were in combat with their P-40s several weeks before the AVG went into action.

—Maxwell Edison  
Dallas, Texas

The article quotes Ken Scheiwe as saying that the best he could get out of a 'Hawk was 260 mph. Ken, you were supposed to pull up the wheels!

—David H. Rust  
Woodville, Texas

"Big Finish" implied that the P-40 Mr. Lumsden sat in at Chino, California, belonged to warbird pilot Steve Hinton. The airplane actually belongs to the Planes of Fame Air Museum.

Also, the caption under the picture on page 70 describes two of the Mitsubishi Zeros used in the filming of the upcoming movie *Pearl Harbor* as replicas. Two of the Zeros used in the film were remanufactured in Russia using the wreckage of a Zero recovered from a crash site in Indonesia as a template. The third Zero used in the film belongs to Planes of Fame. It was

captured on Saipan in 1944 and returned to the States for evaluation. It was test flown by practically everyone in sight, including Charles Lindbergh. After the war, it was acquired by Edward T. Maloney, founder of Planes of Fame. Restored to airworthy condition in the late 1970s, it is the only Zero in the world that flies with the original Nakajima Sakae engine.

—Gordon D. Bergslien, Chief Docent  
Planes of Fame/The Air Museum  
Glendora, California

I can personally attest to the fact that the P-40 has an "overbuilt" airframe. In 1946, while piloting a P-40N over the jungles of Borneo for the Dutch air force, my



engine overheated and seized (we suspected sabotage). There was nothing but jungle below me, so that's where I set it down. Any other fighter, and I would not be writing this. If any landing you can walk away from is a good landing, then I had a good dead-stick landing. That tough old bird is probably still there, deep in the wilds of Borneo.

—Jules E. Scheffer  
Dunedin, Florida

When I took my issue of *Air & Space/Smithsonian* from my mail box last week, I did a double take. For a moment I thought I'd received a duplicate copy of my latest issue of *Flight Journal*, which features the identical cover photograph.

—David Skinner  
Boise, Idaho

### Best of Enemies

While others may disagree, I object to the tone of your recent article on North Vietnamese air aces ("Nguyen Van Bay



and the Aces From the North," Oct./Nov. 2000). I suppose one could argue that your magazine was attempting to tell "the other side of the story" and that there is a long tradition of airmen and soldiers talking to their former opponents. That's all well and good, but it does not excuse the photograph and caption of Nguyen Van Bay returning "in triumph after one of his seven victories." Did it escape your notice that his "triumph" may have come at the cost of an American airman's life? Throughout the article, there are other statements in similarly poor taste. As I read the piece for the third time, I kept wondering what the families of our lost airmen must feel like when they read things like this from a leading American institution.

I understand that the author flew numerous combat missions in Vietnam. As an American, I send Mr. Wetterhahn and all our veterans my sincere thanks.

—Blair Nader  
Friendswood, Texas

*Ralph Wetterhahn replies: We had no problem breaking bread with Saburo Sakai (64 Chinese and other Allied aircraft claimed), Erich Hartmann (352 claims), Gunther Rall (275 claims), Adolph Galland (104 claims), and other aces who killed far greater numbers of Allied pilots under regimes arguably more sinister than the Vietnamese communists. Photos abound of their celebrations. The difference we seem to have here is the sour grapes attitude toward how the Vietnam conflict turned out. I understand that, but in my case I have finally gotten over it after 30-plus years of thinking about it. While I was in Hanoi, one Vietnamese bureaucrat told me, "We won, but we should have surrendered to the Americans the day after the war was over. Then we would have been treated like Japan or Germany." A rather sage observation, I thought.*

*"My position hasn't changed since I last radioed the tower."*

## Revising Rocket History

In "Bumper Crop" (Soundings, Oct./Nov. 2000), Beth Dickey describes the U.S. celebration of the 50th anniversary of the launching of the first two-stage rocket. The launch was certainly a wonderful and historic event. Unfortunately, it was based on a Nazi terror weapon (the V-2) and engineered in part by men recruited from the Nazi missile team. Dickey papers over this awkwardness with a jolly little digression that has Dannenberg, von Braun, et al., dreaming of shooting mail to isolated German islands and shooting explorers to Mars. No mention of the thousand missiles fired at London, each carrying 1,600 pounds of high explosive. (Think of a few Oklahoma City bombings each day, for a year.) No mention of the thousands dead, or the million homes destroyed. But the most wonderful achievement of the V-2 project was this: For every civilian it killed in the conventional way, several slave laborers at the Dora-Mittelbau camp/factory died as well. Such efficiency! The slaves succumbed to malnutrition, disease, and overwork—they were as disposable as toilet paper. Perhaps von Braun and his merry men never knew their rockets were bombing



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cities. Perhaps they never visited the production facilities and saw the carnage there either. Believe it if you like, but don't publish it in *Air & Space*. It's an insult to the dead, and an insult to the intelligence of your readers.

—Harvey S. Cohen  
Middletown, New Jersey

Bumper 8, launched from Cape Canaveral on July 24, 1950, was not the world's first two-stage liquid-propelled rocket. That distinction belongs to the U.S. Army's Bumper-Wac Corporal, launched at White Sands Proving Ground, New Mexico, on February 24, 1949 and the first man-made object to enter extraterrestrial space, achieving an altitude of 248 miles. The July 24, 1950 launch of Bumper 8 was the first significant launch from Cape Canaveral.

—Roland Harper  
Advisory Panel Member  
National Aeronautic Association  
Colfax, California

### Judgment Calls

I usually enjoy your magazine cover to cover, but "Under the Wire" (Above & Beyond, Aug./Sept. 2000) was a poor choice. It is amazing that the individual who wrote the article is still alive, much less still employed in aviation. Accidents happen despite our best attempts to avoid them, and I am not slamming Dave Hirschman for hitting the wire, but he was a complete fool to continue working that aircraft without determining the airworthiness of the machine. I'm

amazed that the Federal Aviation Administration has not paid him a visit based on this story.

But what really bothered me was the positive feeling of the article. The message I got out of it was "What a gutsy guy I was. My boss patted me on the head, and I will do this again if in a similar situation." I definitely did not see anything like "Boy, was I stupid continuing to fly. I'll never do that again." This article has done a disservice to any younger aviator dumb enough to use this guy as a role model.

—Charles W. Weigandt  
Clarksville, Tennessee

### Rough Ride

I may be one of the last living people who was present for Colonel John Paul Stapp's "sled ride" at Holloman Air Force Base, New Mexico, on December 10, 1954 ("First Up?" Aug./Sept. 2000). I was chief of surgery on the base, and one of my responsibilities was to attend hazardous procedures that might result in trauma.

No one knew what was going to happen on this ride, but Stapp pulled 46 Gs and attained a speed of 632 mph. At the end of the track we were standing by with an ambulance, a stretcher, and a basket, as it was unknown whether he would arrive in fragments or whole. He was unconscious when the sled stopped, and I first thought he was dead. He was taken to the hospital and kept for three days, with profound hemorrhages of his body, face, and eyes. He looked as

though he had been run through a meat grinder. He also probably had slight bleeding into his brain. In viewing the onboard movies of the ride, it appeared that all of his soft tissues were being pulled away from his skeleton. He was truly a brave and dedicated man.

—Captain Roger Scott  
U.S. Air Force (ret.)  
Fort Myers, Florida

### Reviving the Unlimiteds

I must respond to the assertion in "Back in the Race" (Aug./Sept. 2000) that unlimited air racing is dead. Granted, sponsorship is key. All one must do is look at unlimited hydroplane racing. I was one of thousands of fans who were sad and disappointed that the sanctioning body involved (the APBA) allowed turbine engines to be included in the class, taking the "thunder" out of our thunderboats. The fans, along with fans of unlimited air racing, came to hear the sound of the greatest piston engines ever built and see them in action. And yet the APBA doesn't seem to have any problem getting sponsors and air time. What does beef jerky or laundry detergent have to do with selling custom racing boats or turbine engines? Does Ford or GM or Lycoming even care? No! The Reno Air Race Association needs to take a lesson from the APBA and model its methods of promotion and keep the breed alive. Over the years, people have come up with all sorts of ideas about "power-to-weight ratio," but the fans don't care.





## LETTERS

Remember the old hot-rodder's adage:  
"There's no replacement for  
displacement."

—Chris Cook  
Incline Village, Nevada

## Two Cheers for Transpo

Thanks for bringing back great memories with "Paris Envy" (Aug./Sept. 2000). As a wide-eyed 11-year-old at his first airshow, I wasn't aware of what was going on behind the scenes of Transpo 72, but I have memories that I will never forget: the huge British Vulcan bomber, the glowing afterburners of the Blue Angels F-4s, the X-15 and Lunar Module on static display, and various warbirds from the Confederate Air Force. I dug out my photos and actual airshow program to show my son.

—Carl Lamers  
Union, New Jersey

Despite being revealed as an over-budget, political boondoggle, Transpo thrilled me as a 10-year-old kid—and gave me dreams of flight. Taking in the show, I truly believed that America was the greatest, most advanced nation on earth, and that flying airplanes would be the absolute best thing that anybody could ever do. And 26 years later it has inspired me to undertake the training that I'm getting now: instruction for a pilot's license.

—Michael Kim  
Manhattan Beach, California

## Corrections

Oct./Nov. 2000 Reviews & Previews, B-36: *Saving the Last Peacemaker* (ISBN 0-9677593-0-7, LOC #99-091876) was written by Ed Calvert, Don Pyeatt, and Richard Marmo. It is available from ProWeb Fort Worth, (817) 534-0209; e-mail: [proweb@flash.net](mailto:proweb@flash.net); Web site: <http://last.b-36.homepage.com>.

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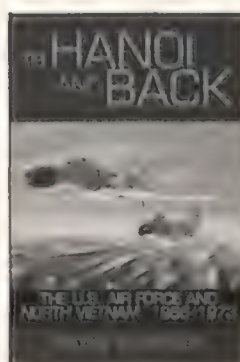
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Foreword by Richard P. Hallion

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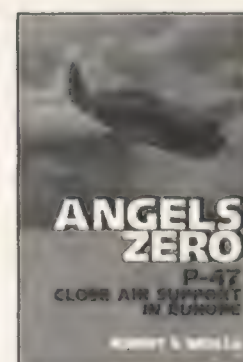
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P-47 Close Air Support in Europe

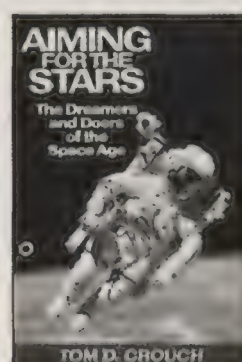
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## Tex Johnston

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Foreword by William Randolph Hearst Jr.

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# MIDWAY



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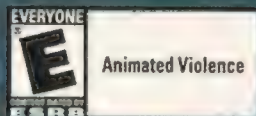
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## Honey, I Shrunk the Solar System

**A**t the top of Maine sits Aroostook, the largest county east of the Mississippi River. Bigger than Connecticut and Rhode Island combined, with a population of only 76,000, the area seems like the outer limits even to Mainers, who refer to Aroostook simply as "the County." It's the perfect place to build a 40-mile-wide model of the solar system, the largest in the Western Hemisphere.

"Other places have constructed solar system models, but not to this size," says project organizer Kevin McCartney, a geology professor at the University of Maine at Presque Isle. "Ours is going to be single-scale and include the systems of moons. It will be roadside, in a remote area, and built to last a long time under

very adverse weather conditions. And we'll have done it basically with no money."

Models of the solar system built to just one scale are rare because both the size of the planets and the distance between them must be consistent. In this case, one Aroostook County mile will equal 93,000,000 miles, the distance from Earth to the sun. At this scale, Mercury is a painted billiard ball, Mars is a fiberglass-covered baseball, and the sun is 50 feet in diameter. One three-story section of the sun, an eight-foot-wide painted wooden arc with strings of Christmas tree bulbs along the front edge, already has been installed in a stairwell at the Northern Maine Museum of Science on the UMPI campus. Pluto, one inch in

diameter, will be placed 40 miles to the south in the Houlton visitor center, at the end of Interstate 95.

The model got its start with a resident who had seen a similar idea in the Northwest. "At least once a week I'd make the long drive from Newport, Washington, up to Ione, past these little signs some high school had put up, representing the planets," says Allen Kulp. When he moved east in 1998 to work at UMPI, he told McCartney that driving U.S. 1 in the

County reminded him of that Washington highway, and "he's taken off with the idea," Kulp says.

"This solar system is inspired, in part, by something the County did earlier," McCartney adds, describing how area volunteers built two large models of historic gas balloons in Presque Isle and Caribou, one covered in tin, the other in fiberglass. "There's a lot of community pride in the monuments," which commemorate the launching sites of the *Double Eagle II* in August 1978, the first successful transatlantic balloon flight, and the *Rosie O'Grady* in September 1984, the first solo balloon crossing of the Atlantic.

The solar system project "has brought an awareness to our students," says welding instructor Kevin Quist at the regional vocational high school in Caribou, where Jupiter and Saturn (large steel frames with fiberglass covers) were fabricated by the welding and auto body classes. School director Lynn McNeal says the students were impressed when "they saw that Jupiter was five feet across, and the Earth only five inches."

DAVID CLARK



"This project helps bring the solar system down to our level," says Dottie Wheeler, director of Burrelle's Press Clipping Serving in Presque Isle, where Mercury will be located in the company's garden. "Burrelle's is delighted to have a part in it."

Scott Norton likes to sit and look at the Earth outside Percy's Auto Sales in Presque Isle, where he's the general manager. "When Kevin first approached me with his ideas, I thought he had just come back from one of the planets," Norton jokes. "But after listening to him, it became obvious that he was serious about making this project happen. I get a good feeling every time I look out my window and see that model of Earth. It kind of makes me wonder if someone else felt the same way when the original was born."

McCartney's real dream, he admits, is "to write a book about where the artifacts of early aviation, pre-1909, can be found." For now, however, his attention is focused on installing nine planets of varying sizes and seven moons in and around the small Aroostook towns—Monticello, Bridgewater, Mars Hill—along U.S. 1.

"This particular project has got a lot of problems," McCartney says. "I feel like the sorcerer's apprentice in *Fantasia*, trying to juggle all these parts. So many different schools, so many different pieces. And the site work—my god, I haven't a clue on how to build a parking lot" for visitors. But he's got lots of support. Students at nine area schools plus several hundred people in all have worked on the project so far. "When people in the County say they'll do something," McCartney says, "you can consider it done."

He adds, happily, "After I spoke at the Rotary Club today, a man said he'd buy me a culvert for Saturn."

—Richard Sassaman

## UPDATE

### Back in Business

Trader Jon's, the Pensacola, Florida tribute to naval aviation masquerading as a bar, is back in business (see "Last Call," Soundings, Apr./May 1999). After owner Martin Weissman had a stroke in 1997, the bar closed and Weissman's family sought a buyer. Last August, Lieutenant Matt Heckmeyer, an instructor pilot at the Pensacola Naval Air Station, and his wife Kerry bought the bar for \$465,000 and threw in another \$150,000 for renovations—none of which will alter the décor. The new owners plan to keep the thousands of photos, model airplanes, Blue Angels memorabilia, and politically incorrect atmosphere precisely as is.



DARRELL OHS

## Last Call for the Martin Mars?

The future of the last two Martin Mars craft, the world's largest operational flying boats, is figuratively up in the air—and worse yet, may be literally on the ground, which would end an era of aerial firefighting spanning 40 years and the *raison d'être* for the Forest Industry Flying Tankers consortium based at Sproat Lake on Vancouver Island, British Columbia.

As a result of consolidations, acquisitions, and mergers among the major forestry companies, the Forest Industry Flying Tankers consortium was down to only two partners: Weyerhaeuser, which contributed 57 percent of the operating costs, and TimberWest, at 43 percent. Last September Weyerhaeuser announced that it wants out of the flying tanker business at the end of the season. TimberWest, along with FIFT general manager Terry Dixon, are combing the western world for new partners, contracts, and applications to rebuild a viable business plan that will keep the *Hawaii Mars* and *Philippine Mars* at work. Dixon estimates that the 56-year-old airplanes have at least 10 more years of service life in them—a claim the FIFT base has been making since 1961.

After an annual review, Weyerhaeuser decided to pull out of the program after considering aspects of "risk management." In other words, the company felt that money spent maintaining the Mars water bomber program would be better allocated

elsewhere—assuming, of course, that the risk of timber losses to fire does not increase appreciably beyond the recent trend.

While the primary role of the Martin Mars craft is to protect the private timber reserves of the consortium partners, several years ago the FIFT adopted a mandate to recover at least half of its operating costs by taking on outside work when the local fire hazard was low. Negotiations began with prospects as far away as Indonesia.

Although forest fires burned five million acres in the United States last summer, it was a slow fire season in British Columbia, with the craft called out on one fire for TimberWest and none for Weyerhaeuser. The *Hawaii Mars* and *Philippine Mars* helped earn their keep with a 13-day sortie fighting fires for the California Department of Forestry and Fire Protection.

But how should the actual value of the service performed by the old Mars bombers be measured? In a way they could be victims of their own success: They may prevent the very disasters that would justify their expense. Terry Dixon admits that this concept can be a tough sell: "If you put out a fire with two or three drops from the Mars," he says, "then what have you saved? An accountant would say 'That cost 30,000 bucks' and a forester would say 'Well you've just saved 10 million dollars worth of wood.' But come January, they're going to listen to the accountant in the boardroom."

—Darrell Ohs



## Just Another Number?

**L**ike so many others before it, the 100th space shuttle mission was late getting off the ground. First came a four-day delay to check out a sluggish valve on *Discovery's* main engines and another potential problem with separation bolts on the fuel tank. That was followed by a day-long hold due to high winds at Cape Canaveral. Finally, on October 10, with the crew strapped in and the vehicle just three hours from liftoff, launch pad inspectors saw with binoculars that a stray four-inch pin—used to secure access gates on the launch tower—was resting on a strut connected to *Discovery*. Managers worried it might hit the rudder-like body flap or an engine nozzle during launch, and decided to remove the pin, a process that involved bringing back the shuttle's service structure, a time-consuming business. Yet another day was lost before the STS-92 astronauts finally roared into orbit.

The last scrub, plainly irritating to launch managers, showed both the delicacy of the nearly 20-year-old Space Transportation System and the price of safety. No wonder the shuttle costs so much, when a tiny thing like an eight-

ounce gate pin can bring the whole massive operation to a standstill. Reporters at the Florida launch site speculated about which unfortunate worker's head would roll. But instead of seeing the glass as half empty, NASA officials gave the pad inspectors a medal. Likening their nit-picking to the never satisfied princess and the pea, Administrator Dan Goldin praised their safety-mindedness and the decision to hold. "God bless these people for that launch delay," he said at the medal ceremony.

Finicky or not, the space shuttle on its 100th flight again proved itself a marvelously versatile machine. Sure, the toilet clogged and the TV transmission antenna didn't work, but the crew of seven astronauts made space station construction work look easy. Four two-man spacewalks in as many days went off with hardly a hitch. Koichi Wakata, a Japanese mission specialist, worked *Discovery's* robot arm with precision and grace, installing two pieces on the station and earning "You da man!" kudos from the ground. The astronauts, including first-time spacewalkers Bill McArthur and

Mike Lopez-Alegria, joked, sang corny songs, marveled at the view, and accomplished every important task on their busy timeline.

Perhaps to avoid jinxing themselves, neither the *Discovery* crew nor mission control was eager to puff up the occasion. To hear them tell it, 100 was just another number. Remarked Commander Brian Duffy during an in-space interview, "Our mission's important, but so's the 99th flight and the 101st flight." Still, some couldn't resist a quick look back. Shuttle launch manager Jim Halsell, himself an astronaut, reflected on the way it was when he joined NASA 10 years ago. Back then, he said, "a spacewalk might happen once a year," and was treated as a dangerous and rare operation.

Now, as NASA looks ahead to five years of complex, interrelated space station assembly flights, spacewalks will be essential and therefore commonplace. The job ahead is daunting. But this 100th flight, annoying launch delays and all, made it look just possible. Said Halsell once *Discovery* was finally off the launch pad, "We've matured."

—Tony Reichhardt



ILLUSTRATION: DAVID PETERS PHOTO: SCOTT ANDREWS



## U.S. Naval Museum of Armament and Technology

China Lake Naval Air Weapons Station  
Naval Air Warfare Center Weapons Division  
Blandy Avenue  
China Lake, CA 93555  
(760) 939-3511

Recently opened at China Lake's Naval Air Warfare Center Weapons Division, which tends to keep a low profile, the Navy's newest museum takes the wraps off more than 50 years of naval air warfare. The collection includes World War II rockets; Polaris, Sidewinder, Shrike, and Tomahawk missiles; 1970s Agile and laser-guided Bulldog missiles; a 1980s Advanced Common Intercept rocket/ramjet air-to-air missile; and the Advanced Bomb Family. The less hawkish will be drawn to the test aircraft on display outdoors, some bearing arcane designations denoting their specialized work—North American QF-86 Sabre drone, Vought DF-8L Crusader drone director, McDonnell Douglas NTA-4F highly modified two-seat Skyhawk. The museum also

ROBERT BEACOM



has the usual suspects, like a Grumman F11F Tiger, Vought A-7C Corsair II, Grumman A-6E Intruder, McDonnell Douglas RF-4B Phantom II, North American RA-5C Vigilante, Bell UH-1 Iroquois, Douglas XF4D Skyray prototype, and

AV-8A Harrier—plus the first production F/A-18A, *Hornet One*. Videos documenting China Lake projects and history are on display. Pick up books, prints, patches, and the requisite T-shirt at the gift shop.

## On the Beach

The dedication of Los Angeles' newly reopened Dockweiler State Beach hang glider park last September was more like a high school reunion, with middle-aged men and senior citizens peering at each other's name tags and exclaiming, "Oh my god, is that you? I haven't seen you in 30 years!"

For some of the early pilots it was even longer than that. Hang gliders first started flying at Dockweiler, a state beach south of Los Angeles International Airport, in 1966. That was when Richard Miller assembled his Bamboo Butterfly, a diamond-shaped hang glider made from bamboo poles and clear plastic, ran down a sand dune, and launched the sport of hang gliding in the United States.

Thirty-four years later, Miller, now 76, returned to Dockweiler, where he sat under a canopy while young hang glider pilots came by to pay their respects. Pilot Steve Wallick brought a brand new Bamboo Butterfly ("I worked on it for five hours and three beers," he says.)

Although this new Bamboo Butterfly flew no better than the old one, no one really cared. The crowd was having too much fun hooting and cheering as fliers ran down the dunes in it and other vintage hang gliders, such as Taras Kiceniuk's venerable Batso.

Kiceniuk, now 46, built the original Batso out of bamboo and polyethylene when he was 17. Quickly realizing its limitations, he designed a high-performance rigid-wing biplane hang glider, Icarus II, with which he amazed local pilots by soaring for hours off the cliffs of Southern California's Torrey Pines in the 1970s. Despite not having flown the Icarus II for more than two decades, Kiceniuk showed on this afternoon that he hadn't lost his stuff. After a practice run in the Batso, he picked up an Icarus V, stepped off the hill, and glided almost to the surf, the most inspiring flight of the day.

For two golden decades, Dockweiler State Beach, with its gentle slopes, mild breezes, and soft sand, had been the premier hang glider training facility in Southern California. Then, in 1986, the county Department of Beaches and Harbors, upon discovering that people were getting paid to teach at Dockweiler, issued a cease-and-desist order.

Joe Greblo, a longtime area hang glider instructor, tried to get the park redesignated as a hang glider training site, but bureaucrats threw up a flurry of objections, including the claim that a hang glider could get caught in an updraft and get sucked into the engine of

MELINDA KELLEY



an aircraft taking off from LAX. It took Greblo 14 years, a letter writing campaign by thousands of hang glider enthusiasts, and pressure from friendly elected officials to overcome the bureaucratic quagmire.

That was all history on Dockweiler dedication day, as a Los Angeles City Council representative declared every September 9 Hang Glider Day in Los Angeles. As if on cue, a flock of 10 pelicans, riding effortlessly along on the ridge lift, soared in V formation directly over the dedication site.

"Here comes the varsity," said a spectator. For anyone who had spent the day running down hills in a Bamboo Butterfly, those pelicans soaring so lightly overhead were a humbling sight.

—Paul Ciotti



## A Lunch, a Bar, and a Microphone

In the late 1940s, when a foreign country set off a nuclear device, U.S. Air Force Special Equipment Operators jumped on airplanes and roared off to collect air samples of the atomic fallout (see "Bomb Squad," June/July 2000). In 1992, when budget constraints made it doubtful that SEOs would continue to fly, the fraternity targeted the 200th day of the year 2000 for a reunion. Having gambled with their health and their lives over the years, it was appropriate that the gathering of about 50, organized around a lunch, a bar, and a microphone, was held at the El Dorado Hotel and Casino in Reno,

Nevada, last July.

SEOs were often assigned unusual tasks, Steve Fritts recalled, such as a classified high-speed photography mission he undertook in a WC-130E "Hurricane Hunter." A TV cameraman's helicopter mount with a built-in seat was modified to fit in the paratroopers' exit door. "Part of the preflight was to don a harness and adjust it so you could not lean past the door's edge," Fritts remembered. "There were no parachutes—your life depended on that harness."

After performing his preflight, Fritts tried, "very carefully," he said, "to get into a more comfortable posture. The

easiest method was to place both my feet on the door sill, one on each side. My right foot slipped into the airstream, and the force pulled me halfway out the door at 22,000 feet. My legs were pinned to the fuselage, and I hung on to whatever I could. I was wildly flailing around for an eternity before they saw me and pulled me in. Needless to say, we modified the checklist to include having another crewman standing nearby."

Darin Pfaff, a still-active SEO, reminisced that on a flight from an air force base in Florida to one in California, he learned only after getting airborne that the pilot planned a "missed approach," ostensibly for training, over Pine Bluff, Arkansas, the pilot's hometown. He had called his mother to tell her he'd be flying low right over their house. Unbeknownst to him, his mother had notified the local media.

"I noticed this is kind of unusual for a missed approach—didn't hear any [missed-approach assigned] vectors or anything like that," said Pfaff. "Someone said, 'Hey, look at that!' I looked out the window and saw streetlights. So somewhere there is archival footage of a four-engine, heavy-duty WC-135 on 'missed approach' right down the main street of Pine Bluff. I'd say our altitude was below 500 feet."

Radioactive fallout, defensive measures by Russia, China, and other countries, and equipment failures weren't the only dangers. Orv Pritchard was once the flight planner of (but not aboard) a WC-135 flight near the coast of North Vietnam in 1968. Thinking the lights below were from the usual numerous fishing boats, the crewmen were alarmed to get a message from the Air Force Technical Applications Center in Washington to "get out of there—you're over Chinese-owned islands." They discovered later that the mapmakers had failed to include the islands on their product. Pritchard said, "I felt even more sheepish when our colonel walked out of his office the next morning with his globe and said, 'See, they're right here.'"

Donna Fritts, one of a dozen or so wives who attended, offered a sober perspective to all the day's fun. "If we had known what they were doing," she said, "we would have had a stroke."

—Bob McCafferty



PHILIP MAKANNA

## Australian International Airshow

Avalon Airport, Geelong  
Victoria, Australia  
February 2001

Australia is throwing an aeronautically lavish birthday party to celebrate the centenary of its independence from Britain and the 80th anniversary of the founding of the Royal Australian Air Force. In what is billed as the largest aerospace event ever held in the Southern Hemisphere, air forces and civilian performers from around the world will headline at the fifth Australian International Airshow at Avalon Airport, 30 miles southwest of Melbourne. Displays will include an RAAF history pageant with static and flying displays, including Mustangs, Spitfires, and Australian Wirraways (above) and Winjeels; a "theme park" of civilian vintage, sport, and homebuilt aircraft; and an airborne pyrotechnic Night Alight program with performances by aerobatic aircraft, parachutists, and jet fighters. The International Aerospace Expo, a series of conferences and symposia for business and industry professionals, will run from February 13 to 16; the airshow is open to the public Friday evening, February 16, through Sunday, February 18. For information call 61-3-5282-4400 (15 hours ahead of Eastern Standard Time) or visit [www.airshow.net.au](http://www.airshow.net.au).



## Slow But Steady

Although the New England Air Museum in Windsor Locks, Connecticut, rescued a Boeing B-29A from an aircraft graveyard in 1973, restoration on no. 44-61975 had progressed slowly. Then, in October 1979, a freak of nature: A tornado roared through the museum's outdoor exhibit, rotating the aircraft 180 degrees, tearing off the number four engine, bending the left main spar, and pelting the aluminum skin with debris.

The museum repaired the tornado damage over the next two decades, but outdoor storage and other priorities sidelined full restoration. In 1999, however, the airplane's future brightened, thanks to the 58th Bomb Wing Association. The 58th Bomb Wing pioneered the use of the B-29 in World War II, operating against Japan from bases in India and China, and the association teamed up with NEAM to restore the B-29 as the centerpiece of the 58th's permanent memorial at the museum. NEAM has put all other projects on hold to complete the memorial. NEAM project coordinator Dennis Savage and restoration crew chief George Damato manage a crew of some 30 volunteers working three days a week. The team removed the Wright R-3350-57 Cyclone engines and completely restored the number-one engine. Hamilton Standard, the original propeller manufacturer, refurbished the 17-foot props. The horizontal and vertical stabilizers were reconditioned.

DENNIS SAVAGE



Sheet metal work on the stabilizers and elsewhere has proved particularly tedious. Stripping the gray paint revealed dents patched with auto-body filler. Because the airplane will be displayed in a natural metal finish, the sheet metal team decided to cut away and replace these areas in accordance with Air Force repair specifications. Corrosion in the bottom panel of the tail gunner's position presents a difficult fabrication challenge: A new aluminum panel must be rolled and tapered, and suitable equipment has not yet been located.

Other components surfaced serendipitously. While Damato was on the phone with a California parts dealer discussing another aircraft, the dealer stumbled across the Army Air Corps

data plate for the museum's B-29 in his shop. A radio was donated, and spare plastic astrodomes and gunner's blisters were found at the Confederate Air Force headquarters in Midland, Texas. Though the airplane still lacks a number of components, including several gunsights, Damato says, "We all have a very positive attitude that we are going to be able to find everything." The Boeing plant in Wichita is restoring a B-29 to flying condition and the museum has done some parts swaps with the plant: NEAM sent its vertical stabilizer, which can be made airworthy, to Boeing in return for theirs, which is good only for static display. The NEAM team is thrilled that at least part of its airplane will fly again.

—Stephen M. Ritz

## Bring Me the Head of Triceratops!

Last August an Evergreen International Aviation DC-9 taxied up to the Signature Flight Support ramp at Dulles International Airport in Virginia, where staff members from the National Museum of Natural History waited on tenterhooks. In the cargo bay, strapped to a pallet and draped in white cloth, was a mega-skull, with three mega-horns poking through the fabric.

When Kathy Hawks, a conservator who knows her dinosaur bones, examined the Triceratops skeleton in the National Museum of Natural History two years ago, she didn't like what she saw. The skeleton, assembled from a group of the plant eaters' remains dug up more than a century ago, was deteriorating badly and would need emergency preservation measures. Before the skeleton was disassembled, though, it was scanned into a three-dimensional digital map that could be stored in a computer for reconstruction later.

Richard Benson, chairman of the NMNH's paleobiology department, knew that the skeleton had been assembled

from parts of a dozen animals found in the original dig, plus some...well, off-the-shelf items: Hadrosaur (a duck-billed dinosaur) feet were substituted for missing Triceratops hind feet, the equivalent of restoring a Chevy pickup with a Ford tailgate. Even worse, the skull was discovered to be at least 15 percent too small for the rest of the skeleton. With the digitized skull in a computer file, it was possible for the combined talents of Shared Replicators and Tulsa Technologies, both of Tulsa, Oklahoma, to fabricate a plastic three-dimensional model of a skull to the correct size.

But Benson knew the final product, which would be used to construct a mold to cast the skull reproduction, was both heat- and light-sensitive. They couldn't just load it on any old truck and drive it to Washington, D.C. The cost of renting a special shock-, heat-, and light-proof truck and trailer was prohibitive, and an attempt to line up a military transport got wrapped in red tape. Benson told NMNH director Bob Fri about his problem, and

Fri called his friend Jack Dailey, director of the National Air and Space Museum.

After Fri's phone call, Dailey got on the horn to Tom Lydon, Washington representative for Evergreen International Aviation, a world-renowned air cargo firm in McMinnville, Oregon, and founded by Del Smith. "[Smith] had offered this type of support to me before, which is why I called [Evergreen]," Dailey recalls. Lydon determined that the skull would fit in a DC-9. Next he memoed Smith, who agreed to provide the skull airlift. "One of the nice things about working for a company like Evergreen is that although we're big, we're still small enough that you can ask the chairman a question," Lydon says.

And so an Evergreen DC-9-15F did fly from Columbus, Ohio, last August 21 to Tulsa, did load one full-scale reproduction of a Triceratops skull, and did deliver same to the waiting forklift of Dick Benson. Sometime next winter, visitors to the NMNH will be able to see the finished product, horns and all.

—George C. Larson



## The Japanese Connection

Two delicate paper dragons occupy the cockpit of the Aichi Seiran, a 1940s-era Japanese dive and torpedo bomber recently restored at the National Air and Space Museum's Garber facility in Suitland, Maryland. The dragons were sent to the Museum specialists who worked on the Seiran by a leading origami instructor who had been an engineer for the Aichi Aircraft Company in Nagoya, Japan, more than 50 years ago. The artist is one of a group of former Aichi workers and military veterans who, during the past few years, have given unprecedented support and assistance to the Museum's rejuvenation of the Seiran, whose top-secret mission was to take a stealthy submarine ride across the Pacific and bomb targets in North America.

"We have many times more information about the Seiran than when we started the project" in 1989, says NASM restoration specialist Bob McLean (right, standing in front of the Seiran), who was the main contact with the restoration's collaborators in Japan. "Our Japanese friends have been extremely important to the accuracy of the final product." Representing the Japanese friends has been Tetsukuni Watanabe (his American friends call him 'Tet'). Watanabe is a recently retired quality assurance specialist with Aichi Machine Industry, Ltd., Aichi's postwar incarnation, which manufactures parts for automobiles. For the past eight years, Watanabe has been talking shop with former Aichi Aircraft workers (like the origami artist), seeking information and documentation about the company's unusual wartime product.

"I have liked model planes and warbirds since I was [a child]," the 57-year-old Watanabe explains in a recent e-mail exchange. He began researching the history and engineering of Aichi Aircraft in 1992, an undertaking that led him to contact the Museum. When he started, he says, there were more than 40 former Aichi employees who could supply him with the materials that would later prove so valuable in the Seiran's

restoration.

Today, Watanabe puts their number at about 10. "Many Aichi old boys [are] gone," he laments.

Through the 1990s Watanabe grew close to the Aichi veterans, visiting their homes and helping with odd jobs. He rallied them and some of their family members to support the 10-year-long Seiran

restoration taking place halfway around the world. "These fellows over there," says McLean, his voice full of admiration, "they're working on their own time and on limited budgets, and have given incredible cooperation to us, relative strangers, to make this restoration a success."

Watanabe and others gathered information and materials, including planning documents, designers' drawings, and detailed diagrams of original components. They hosted McLean when he made a visit to Japan in 1999, and they helped him make contact with a Seiran mechanic, a former Seiran squadron commander, and a test pilot. Finally, Watanabe and others helped the restorers at Garber by translating engineering documents and other material, which went immeasurably further than mere photographs toward rebuilding the Seiran. McLean calls the result of the exchange "certainly one of the most successful bones-to-complete restorations of Japanese aircraft anywhere in the world.

"The most perplexing mystery of the airplane, for me, is how things are configured on the interior," continues



McLean. "A lot was missing when we got ahold of the Seiran. We had the choice of restoring the relatively empty aircraft with whatever we had, or creating replicas to make it at least look right. And there are an infinite number of fine points between those two options as well." Now the Museum has an airplane that is more authentically restored than anyone would have thought possible.

The 7,200-pound Seiran was an ingenious response to a directive issued by Japanese military leaders for a weapon that could attack U.S. cities. To overcome the distance, the Seiran worked in conjunction with the huge Japanese I-400-class submarine. Three of the bombers fit into an 11.5-foot-wide hangar tube inside the sub. The Seiran's wing spars rotated and allowed the wings to fold and tuck against the fuselage. The supersub was to make the journey across the Pacific and surface within flying range of the target. Then a carefully choreographed crew would open the hangar tube, unpack the first of the amphibious bombers, attach its floats, start the liquid-cooled engine, and catapult the manned Seiran from the sub's



deck—all within a period of seven minutes.

When the floatplanes returned from their mission, a crane would lift them out of the water, allowing crews to remove the floats, fold the wings, and stuff them back into the cargo hold for the trip home. Two Seiran-laden submarines were on their way to Micronesia in August 1945 when the Japanese emperor surrendered. By that time, Aichi had manufactured 28 of the airplanes.

The Museum's Seiran, the only survivor, sports some wartime doodlings, likely drawn by Aichi factory workers wielding pencils and etching tools on the aircraft's skin. Aside from some anti-Allied graffiti, there is a carefully etched drawing of a geisha and a few nonsensical English letters and words, perhaps someone practicing his command of the language.

Watanabe's group has been able to shed some light on the history of the Museum's artifact. Evidence indicates that it was the last Seiran off the assembly line in Nagoya before the region was occupied by Allied troops at the end of the war. Shortly after, the aircraft was shipped by the U.S. Navy to the Alameda Naval Air Station in California, where it was stored for several years. The Seiran arrived at the Museum's Garber facility in 1962.

"We've seen a lot of ongoing relationships because of this contact," McLean observes. "Because we all share a fondness and fascination for historical aircraft, we have a lot in common with [the Japanese workers]—more, perhaps, than with many people in our own culture. We've been able to communicate on a level that is completely unexpected."

The sentiment is echoed by Watanabe, who notes that the "airplane fan's heart is same [anywhere] in the world."

—Topper Sherwood

## Squeezing Past History

Twenty-two years ago, the ungainly and fragile Gossamer Condor was installed in the National Air and Space Museum. I had created the aircraft for one purpose: winning the Kremer Prize for sustained-control human-powered flight as expeditiously as possible. I never considered that it would end up in the Museum, so the airplane was built in one piece. After my team won the prize, the Museum asked if we would donate the craft, and we agreed. Before it could go on display, however, the Gossamer Condor had to be cut into several portions, then trailered to the Museum and reconstructed in place. Last February, to accommodate an ongoing

series of restorations to the Museum's walls and ceilings, the aircraft had to be temporarily moved from its home in the Pioneers of Flight gallery to a display area in the Museum's west wing. The Museum asked me to help with the move.

The delicate six-hour moving operation required four lifts, special tools, a number of wonderful Museum helpers, my son Tyler MacCready, who handled some test flying and building tasks when the GC won the Kremer Prize, and Taras Kiceniuk, who helped in the construction and testing of the GC. The craft was just barely able to squeeze by a number of aeronautical legends that stood in its way. The GC journeyed along, and jostled against, such famous vehicles as the North American X-15, *Spirit of St. Louis*, Lockheed F-104A Starfighter, Ford Trimotor, and Douglas DC-3. The GC also had to maneuver its way around the Einstein Planetarium's ticket booth. After measurements, planning, and procuring appropriate tools and materials on February 8, the Gossamer Condor move was made the next day.

Tyler MacCready was the operations strategist and vehicle manipulator, working from the highest lift. Kiceniuk was co-strategist, often operating a smaller lift to support the aircraft from below. All three of us had participated in the winning of the second Kremer Prize, the 1979 crossing of the English Channel by the Condor's offspring, the Gossamer Albatross. The pressure of that project had exhausted us almost as much as it had the pilot/pedaler Bryan Allen. After the six-hour ordeal of moving the Gossamer Condor into its temporary quarters, we all agreed that the stress level was comparable to that we'd experienced two decades earlier.

Sometime, probably in late 2000, the GC will have to be returned 200 feet east to its former spot. The move won't be any less laborious next time around, but at least now we know about the need to move the Trimotor's aileron.

—Paul B. MacCready

## MUSEUM CALENDAR

**December 7** "The Search for Life in the Universe." Neil de Grasse Tyson, director of scientific research at the Hayden Planetarium in New York City, will discuss his views and the latest developments in the search for extraterrestrial life. Langley IMAX Theater, 7:30 p.m.

**December 16** Special Star Lecture. The winter night skies will form the backdrop



These Painted Lady butterflies flew aboard the space shuttle *Columbia* during mission STS-93 in July 1999. They were the subject of an experiment, developed by a group of high school students and their instructors, to investigate how weightlessness affects the life cycle of butterflies. Aboard the shuttle, the caterpillars formed cocoons from which normal butterflies emerged, showing that metamorphosis can occur in space, without the influence of gravity. Butterflies and other pollinating insects may be useful in future space gardens.

for a virtual tour of the National Air and Space Museum's upcoming gallery on observational cosmology, *Explore the Universe*, scheduled to open in September 2001. Einstein Planetarium, 6 p.m.

### What's New?

Curators, researchers, and astronomers gather every Thursday at 3 p.m. in the Einstein Planetarium to discuss the latest developments in astronomy and space exploration. This program is free and open to the public December 7 through December 28.

### Curator's Choice

Once a week, a National Air and Space Museum curator will give a 15-minute talk about an artifact. Meet at the Museum Seal in the Milestones of Flight gallery at noon. Dec. 5, "Yuri Gagarin's Sk-1 spacesuit"; Dec. 12, "The Trimotor in Latin America"; Dec. 19, "Messerschmitt Me 262, the World's First Operational Jet Fighter" (this will be the last Curator's Choice until February).

*Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700; TTY (202) 357-1729.*



## "Aw, Hell, Television Is Here"

**O**n August 17, 1958, there had been a 76-second opportunity for euphoria to build and for Americans glued to their TV sets to cheer. At 77 seconds, that excitement ended in a massive fire-laced cloud of white smoke. A first-stage failure at 50,000 feet sent the remains of a Thor-Able rocket and its lunar probe into the waters off Florida.

The occasion was the first "live camera" coverage of a space launch from Cape Canaveral. With no direct-transmission lines available, the film was sent to the West Coast, taped, and replayed back to New York for NBC's "Today Show." The first truly live telecast, that of another Thor-Able's successful launch of the Pioneer I lunar probe, would take place on October 11. My colleagues at the Jacksonville, Florida television station WFGA-TV were responsible for both.

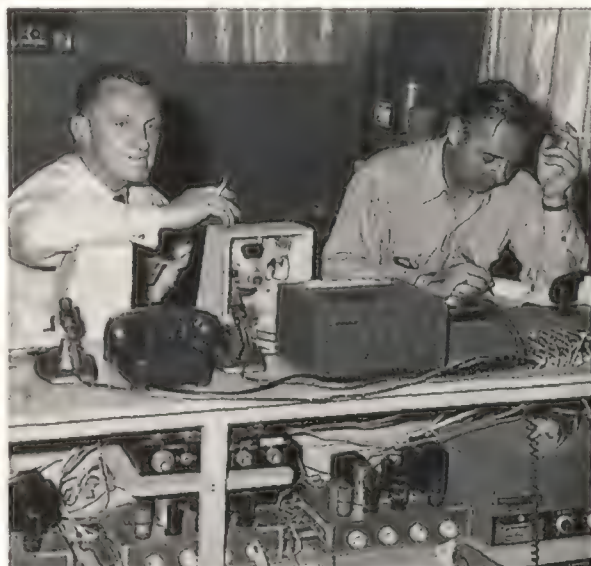
The video and audio for each had been the responsibility of station manager Jess Cripe, complicated by technical limitations of the era and an Air Force edict outlining stopwatch-precise restraints. Foremost, not until "after fire in the rocket's tail," it read, could any video be transmitted to the public. The rationale, the Air Force conceded, was to avoid the embarrassment of broadcasting mishaps or scrubs.

There had been multiple rules and restrictions complicating 1957 and early '58 coverage of the U.S. space program. Those of us at WFGA-TV had generally managed to cope with most of these, so WFGA was designated the "pool feed"—the sole engineering and production facility servicing all the national television networks. Our transition into that role had begun in late 1957, after Russia had launched an intercontinental ballistic missile in August and put Sputnik I in orbit in October. What had been sporadic news coverage of U.S. missile and rocket programs by the networks suddenly assumed competitive priority.

Quickly, Jim Kitchell of NBC Television had sought a permanent

network presence at the Cape through one of its affiliates, our own WFGA. Despite our having been on the air only a few weeks, Kitchell had liked our style. Cripe was enthusiastic. He thought pioneering TV coverage of the space program would be fun.

Further, WFGA reporters and cameramen had been at Canaveral covering all types of rocketry, from captured German V-2s to more sophisticated space probe forerunners. The station had set up a full-time TV news bureau, and every launch and briefing, no matter how insignificant, was being covered. Cape officials were



*Common to all eras of spaceflight: the boredom of waiting out a launch delay.*

well aware that WFGA was there.

So did the NBC assignment desk in New York. It had interest in the black-and-white film we had shot from dunes south of the launch sites, which later would include a spectacular failure of a Vanguard launch vehicle on December 6, 1957, a copy of which was requested by Cape scientists. As a result, our news teams were among the first allowed at the launch sites in January 1958.

Cripe and Kitchell were beginning to forge a working relationship that would span three decades. They also started nagging a reluctant telephone company to provide TV relay facilities in the

Canaveral area. In the interim, they used motorcycle couriers, a light aircraft from nearby Merritt Island, a police escort in Jacksonville, and fast processing to get film on national television in less than 90 minutes. The first example was the January 31, 1958 launch of Explorer I, the first U.S. satellite, by a Jupiter C.

Our peers may have been impressed, but apparently not so the Air Force or, later, NASA. When it came to providing facilities for the pictorial media, television was number two on their list. Our film crews worked at ground level, and they and their cameras were inevitably caught in the swirl of sand and dust created by military helicopters making last-minute security sweeps. Looking down on them, literally, were cameramen who filmed for the newsreel companies; they had choice spots atop a nearby building.

Such favoritism survived only until the first use of live TV cameras on that August day in 1958. The Air Force had simultaneously authorized direct feeds and construction of a temporary relay tower. Kitchell had contacted CBS and ABC, worked out details for pooled coverage of the launch, and told Cripe, "You've got 36 hours; get down here!"

Cripe had doffed his suit and tie and resumed his pre-WFGA status as a hands-on engineering supervisor. Most equipment for that first televised launch ranged from makeshift to barely state of the art. The spindly-legged 30-foot relay tower had but a four-foot-square reflector on its top and a microwave dish on the ground angled upward. The control center, by default, was WFGA's none-too-commodious remote van where Kitchell, elbow to elbow with operating engineers, would make his switching decisions between two cameras, one that tracked the rocket and one on the ground for crowd reaction. As WFGA's camera was hoisted to the roof, its arrival elicited an almost prophetic goodbye from one of the newsreelers. "Aw, hell," he said, "television is here."

For 40 seconds after liftoff, the Thor-





*On the National Registry of Historic Flatbeds: one of the first film and still photographer platforms provided by the Air Force.*

Able blazed straight up. Working with a tripod-mounted heavy unit, Bob Knott had cleanly paced his camera lens with the rocket's early acceleration. But as it continued to ascend, he had to tilt the camera back to its vertical limits and, as he slid down on his back, Cripe and others tilted back the mount by its front leg and strained to hold the combined weight steady. Others propped up Knott.

Viewers saw the rocket rise squarely in the middle of their screens for those 76 seconds and then the aftermath. Newspaper readers would see a United Press photo of Knott and his support system, the caption likening it to the photo of the flag raising on Iwo Jima.

The camera mount was revised, and in October, early tracking of Pioneer I's record-setting 71,000-mile flight had been almost perfect—though the moonshot ultimately fell far short of its target. For months, an Air Force colonel had shared space in front of wooden bleachers with our news cameramen, animatedly keeping his superiors in Washington apprised by phone about each launch. As Pioneer lifted off, he cradled the phone and turned to me. "Looks like I'm out of a job," he said. "They're seeing it on TV."

Such success did not ensure WFGA's eventual role in the space program. Upon petition by CBS, one of its own affiliates was granted the pool feed rights for the next telecast, the third lunar probe, on November 8. The third stage of the Thor-

Able failed to ignite. In turn, the cameraman lost the rocket shortly after liftoff, and the TV audience saw mainly only contrails. Weeks later, on December 6, WFGA was back for Pioneer III, the fourth lunar probe, which reached 65,000 miles before its Juno II launch vehicle malfunctioned.

The next two years were to be a transitional period for the U.S. space program and for our coverage. NASA was preparing for manned spaceflight. WFGA was outfitting two house trailers for itself and NBC with studio space and the latest camera, recording, and transmittal equipment.

Those forerunners to today's vast Cape media complex were an instant attraction for military brass and civilian scientists who, to our amusement, beat paths through the dune grass to view a technology they coveted. For more than a year, they had sought lighted buttons for their multi-line telephones, but had been thwarted by a contract service that, among other excuses, had cited the questionable quality of local lines. Our trailers had them, though, and they worked on those lines. Within weeks, phone buttons were lighting up all around the Cape.

Herb Gold, our film director, began a lengthy relationship with NBC that in time would make him co-recipient of an Emmy. He had close ties to NASA's manned spaceflight program and got to

know most of the early astronauts. In turn, anyone who made significant contributions to any phase of the pool coverage would be recognized at the Cape by our red hard hats with WFGA and NBC lettering and an array of exotically named rockets and launch dates across the back.

That included astronauts. John Glenn acquired his hard hat in July of 1962 when, with Gold as operator and Glenn describing their surroundings, a camera was allowed into mission control for the first live beaming of a U.S. civilian signal to Europe via the Telstar I satellite.

We nurtured our relationships with astronauts. When Glenn became the first American to orbit Earth and went into isolation for medical attention and evaluation after splashdown off Grand Turk Island, NBC and our crew sent him bagels, cream cheese, and lox. Such interaction was crucial. NASA could be most secretive about reasons for launch delays and often would not alert the media. NBC would have beach parties the night before each scheduled launch of note. If the astronauts showed up, we would know the launch was off. No-shows by them and key NASA personnel would indicate all was on schedule.

Only once did that system fail. In May 1962, Scott Carpenter came, ate, drank—and orbited Earth aboard *Aurora 7* the next day.

—Harold Baker



# The Light Brigade

In the fading evening light of March 15, 1938, my mother, father, and I were sitting in the living room, listening to the radio. Suddenly, the program was interrupted by a dramatic message—and an urgent appeal. Eighteen Army Air Corps airplanes, flying from Selfridge Field in Michigan to Tampa, Florida, needed to make an emergency landing in our town.

The airplanes had been planning to make a refueling stop at Maxwell air base in Montgomery, Alabama, but they had encountered stormy weather and headwinds near Birmingham and were now low on fuel. Unable to contact the Birmingham airport, the squadron's leader, Captain D.M. Allison, chose to backtrack to our town, Huntsville, where the weather was reported to be less severe, and try for a landing there.

Night was setting in when the pilots spotted a huge lighted sign advertising the Hotel Russel Erskine. The 12-story structure was our tallest. But other than that beacon, Huntsville, a cotton mill town with a population of 11,000, had little to offer: an unlit grass field with a shed and a tattered wind sock. Certainly no control tower.

Two state troopers, who had been observing the aircraft in the dark and roiling sky, realized the pilots' problem and rushed to notify a local radio station. Interrupting its regular program, the station issued an emergency appeal: Townspeople were needed to drive to the airstrip, encircle it with their cars, and use their headlights to illuminate the field, helping the pilots land.

My family was among the first to arrive. As a teenager enamored of every element of flying, I could hardly contain my excitement as the first Seversky P-35, spitting blue flame from its exhaust manifold, swooped out of the darkness into the pool of lights, touched down, bounced skyward, settled back to the ground, braked, and then, engine roaring, taxied to the edge of the field. "Those are

*Later famous as a center of rocketry, Huntsville, Alabama, got its start in flight support in 1938 when residents helped a P-35 squadron make an emergency landing.*

fighter planes!" I yelled to my parents, hoping they would appreciate my aeronautical wisdom.

That first airplane, as it turned out, was Captain Allison's, who could now use his radio to act as ground control. One by one, the remaining 17 airplanes peeled out of their circling formation through the gusty winds. All landed without incident except the last. We held our breath as the pilot, his aircraft yawing wildly, gunned it for another circuit around the field. On the second attempt he brought his airplane in for a bumpy but successful landing. The crowd at the field exploded into a cheer.

In the surge of townspeople following the landings, I managed to shake the hands of most of the pilots, including Captain Allison's. I was to keep the hand that had shaken those of the gods unwashed for days.

The pilots arranged their P-35s in smart military alignment along the field and secured protective covers over the engines. City police and others volunteered to stand guard overnight. I would have too, but my parents reminded me about school the next morning.

Captain Allison lavished praise on his "boys"—the 17th Pursuit Squadron—for their ability to fly so skillfully under such pressure. "Thank God for Huntsville," he told our mayor. "I don't know how we could've survived without you people." Later, I overheard one of the pilots say:

"I'm just thankful we all came down right side up."

The pilots were escorted to the Russel Erskine hotel, whose sign had served as a beacon to guide them in the darkness, and the hotel staff offered them libations in the locally famous Blue Room. My friend Jimmie Taylor, who was a bellhop there, told me that one of the pilots, an "obvious Yankee," recalled worrying that the squadron would have to land in one of those stubbly "grits fields."

After the Blue Room fête, the pilots were treated to a sumptuous meal in the banquet hall and were given the best hotel rooms. Arrangements were made for a delivery of aviation fuel.

Early the next morning a tanker from Birmingham arrived. By 2:00 p.m., the refueling was completed. The squadron took off.

In the days to follow, many of us relived those daring landings over and over in our minds. They had been a dramatic event for our quiet little town. We heard that some of our citizens, without benefit of radio, had taken the noise of the aircraft to be an approaching cyclone and had rushed to their cellars. But a number of citizens had witnessed—indeed, been a vital part of—the most exciting event in Huntsville, some said, since 1863, when Confederate General Nathan Bedford Forrest and his cavalry had run off a Yankee general and his soldiers.

—Walter S. Terry



COURTESY JAMES B. HILL JR.



*"Patty, girls don't become pilots!"*



CAROLYN RUSSO

— PATTY WAGSTAFF

Three-time U.S. National Aerobatic Champion, whose F-16 is on display at the National Air and Space Museum as part of the Smithsonian's Lockheed Vega.

*Oh yes they do. And Patty Wagstaff became the best — among men and women. Today, she's a champion aerobatic pilot, air show star, aerobatic coach and trainer, writer and lecturer.*

*She's also a member of the Smithsonian Legacy Society, as one of many benefactors who has included the National Air and Space Museum in their will.*

*Find out how you can include the National Air and Space Museum in your estate plans. Fill out and return the reply form below: or call 202-357-2493. You may also e-mail [gayle.union@nasm.si.edu](mailto:gayle.union@nasm.si.edu). Help us reach our fullest potential!*

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Smithsonian  
National Air and Space Museum



# KOSOVAS

## MEMORIES OF

*by Jonathan Knaut*

A HELICOPTER  
PILOT RECALLS  
HIS PEACEKEEPING  
TOUR OF DUTY  
OVER ONE OF THE  
WORLD'S MOST  
STRIFE-TORN  
REGIONS.

**A**s I awaken to my alarm clock, I can see my breath in the dark, stale air. Our generator must have died during the night. It is 5:30 a.m. in the middle of January in the Yugoslavian province of Kosovo, and according to my thermometer it is eight degrees Centigrade (46 Fahrenheit) inside our six-man shelter. I have to get moving; I have three missions today, and the

first briefing commences at 7:00 a.m.

Walking outside at 6:30 to load my survival gear into the aircraft, I find the flight engineer, Master Corporal Alain Bilodeau, brushing the snow off our aircraft, one of eight Canadian Forces CH-146 Griffon helicopters supporting the NATO peacekeeping mission here. A 1990s version of the Vietnam-era UH-1 Huey, the Bell Helicopter Textron Canada model 412CF

Griffon is a tactical utility helicopter, with twin engines driving a four-blade main rotor.

Outside it is below freezing, and over a foot of snow has fallen overnight. By 7:00 a.m., the aircraft commander, Captain Stéphane Roux, and I have checked the weather, had our intelligence briefing, and planned the mission. We all look tired—no one slept well last night with the heat





*A Canadian Forces crew of the 430 Escadron Tactique d'Hélicoptère uses a hot-air blower to defrost the rotor blades of a Bell 412CF Griffon and prepare it for flight.*

JONATHAN KNAUL

off. At 7:30 a.m. we start the engines, and it will take almost 20 minutes to warm up all the systems. As aircraft commander, Stéphane is the decision-maker who has primary responsibility for both the aircraft and the mission. We'll usually share stick time, but as first pilot, I will be the one doing most of the flying, and I had better be on the ball today: We'll be operating in a known threat zone, and

there is no room for complacency.

At 8:15 a.m. we land at the Finnish battalion camp near Lipjan, some 10 miles south of Pristina, and pick up four special reconnaissance soldiers. Our first mission is to provide an eye in the sky and top cover for a series of house raids being conducted by Finnish troops with dogs and armored vehicles. The soldiers in the back of our aircraft, equipped with radios in

addition to their personal weapons (nobody goes anywhere in Kosovo without a weapon), will monitor the scene from above and coordinate the effort.

The Finns have intelligence reports that several houses in a particular Albanian village are harboring arms and drugs. An hour into the raids, there has been some resistance and several arrests have been made. By 10 a.m.



**A TURKISH ARMY** IN 1389 DELIVERED A CRUSHING DEFEAT TO SERBIAN FORCES LED BY PRINCE LAZAR. THEN LEFT THE BODIES TO BE PICKED AT BY CARRION BIRDS. SERBS CALL THIS PLACE THE FIELD OF BLACKBIRDS. AND IT IS SAID THAT THE SOUL OF THE SERBIAN NATION RESIDES HERE.



we are back at the Canadian camp, refueling our aircraft “hot”—with the engines running and the crew strapped in and ready to go. Within 30 minutes we are airborne again and back over the scene of the raids.

After another hour and a half the raids are completed. Several assault rifles and some illegal drugs are seized, and a few people are taken into custody. In the backyard of one Albanian house, the Finns find several graves. We can only speculate about the bodies; the conclusions will be left to the United Nations investigators, who will arrive later. There are many graves in Kosovo.

**L**ess than three miles northwest of the town of Pristina, on a ridge overlooking the town and a broad plain that sweeps beyond it, stands a simple brown monument about 100 feet tall. It dominates the landscape, and although it offers a natural visual checkpoint, we avoid flying near it because of what it symbolizes. The

monolith commemorates an epic battle fought on June 28, 1389, when a Turkish army under Sultan Murad I delivered a crushing defeat to Serbian forces led by Prince Lazar, then left the bodies to be picked at by carrion birds. Historical records suggest that as many as 70,000 people died during this daylong battle. Serbs call this place the Field of Blackbirds, and it is said that the soul of the Serbian nation resides here.

In the spring of 1987, Slobodan Milosevic, then the Serbian Communist party leader, came to Kosovo and, before an attentive crowd made up mostly of Serbs resentful over treatment by local Albanians, stated, “Nobody, either now or in the future, has the right to beat you.” With those words, Milosevic aroused Serbian nationalism and hatred for the other ethnic groups in the crumbling nation states of Yugoslavia, thereby consolidating his hold on power. By the early 1990s, widespread ethnic warfare had devastated this Balkan region.

To the west of the monument, at Obilic, lies a coal-burning electrical plant, and when the winds are from the north, we can see the brown swath in the snow extending for miles beneath the acrid plume that emanates from the plant’s smokestacks. Just south of Obilic lies the town of Kosovo Polje (*polje* is Serbian for “field”), which is a suburb of Pristina. For me, Kosovo Polje is a microcosm of Kosovo the province. It is one of the few remaining settlements in which Serbs, Albanians, and Gypsies still live together. But “living together” is not really accurate: In the months that I have been here, scarcely a day has passed that a house has not been set on fire.

**L**ast year, in the spring of 1999, I volunteered to join a Canadian Forces contingent that would help keep the peace in Kosovo. I was just one of about 48,000 troops from more than 30 nations involved in the Kosovo Force, or KFOR, the United Na-

*This Serb barracks was bombed out, but the adjacent parade ground, now a NATO landing pad, was untouched.*



JACQUES BOUCHER





CANADIAN ARMED FORCES PHOTOGRAPHY LIBRARY

tions-mandated, NATO-led peace-keeping mission that began on June 12, 1999, after the bombing campaign against Serb paramilitary forces ended. In March 1999 I told my mother that I would be sent on military duties in the Balkans. It was the kind of thing no mother wants to hear, especially not my mother, who had spent her teen years in London during the German bombing.

On December 18, 1999, I arrived in the Canadian camp at Donja Koretica, or DK, just a 30-minute drive west of Pristina, along with my squadron, 430 Escadron Tactique d'Hélicoptère,

from Quebec City, Quebec. Our unit here carries the name KRWAU, for Kosovo Rotary Wing Aviation Unit. But the acronym KRWAU is pronounced "crow," a coincidental reminder of the ever-present blackbirds that infest our hangar. We are crows among the blackbirds.

The Griffon I will fly can carry up to 15 people and has a maximum gross weight of 11,900 pounds. It has armor in both the floor and the crew seats, a 7.62-mm automatic rifle mounted on the cargo door, and missile warning systems. It can handle instrument flight in non-icing conditions, and the avionics package includes all the traditional navigation aids, supplemented by GPS satellite navigation for position data and Doppler radar systems that measure velocity over the ground. With all of the extra equipment we carry, the empty weight of the helicopter is relatively high—often in the neighborhood of 9,000 pounds. Fuel for 90 minutes of flight plus a reserve adds 1,400 pounds. That leaves room for a payload of 1,500 pounds, which means

that we can typically carry a maximum of five passengers.

Shutting down the helicopter at camp DK at noon, I can feel the cramps in my legs as I clamber out of the cockpit. Armored seats are made for protection, not for comfort. The crew and I have been strapped in for more than four hours, and we are eager to stretch and eat some lunch. There is not much time as we still have two more missions to fly before our day is over.

Shortly before 1:30 p.m. we land on the Kosovo side of Gate 3, one of the main border crossings into Serbia, guarded by both British and Canadian soldiers. Here we pick up a British lieutenant, two soldiers, and an Albanian interpreter. For the next hour we patrol along the border with Serbia looking for any signs of the Serbian special police. NATO established a buffer zone about three miles wide on the Serbian side of the border within which only Serbian border police are allowed. Any other Serbian armed forces are prohibited from entering.

The terrain here is deceiving: very

*Master Corporal Bruno St. Laurent, flight engineer, scans for threats through a door that's open to bone-chilling cold.*



CANADIAN ARMED FORCES PHOTOGRAPHY LIBRARY



mountainous and serene. To the untrained eye it appears tranquil, with barren, high, windswept hilltops, few inhabitants, and not much activity. But we are not the only ones patrolling here; we can hear Czech ground reconnaissance teams on the radio. Day or night, no matter what the weather, the Czechs are on watch, though they are so well concealed you will never see them. I must remind myself that to the Serbs, KFOR is an invading and occupying force in a province that legally belongs to Yugoslavia. Most Albanians welcome NATO, but for those people who still constitutionally own Kosovo, Canadians and NATO are anything but welcome here.

Our patrol takes 45 minutes and proceeds without incident. We are to drop off our passengers at an Albanian house located on a mountain-top. Small isolated dwellings like these can be seen all along the border. This particular house is situated in a bleak location several miles from civilization. The British lieutenant tells us that a couple, both in their 70s, live here. They have no automobile or

tractor, no means of resupplying themselves. The British officer visits frequently with medicine and food.

With the winds gusting, we land near the house. The elderly couple approaches, hunched over and walking with long canes. They are both dressed in light clothing, and their only guardian is an emaciated German shepherd. We leave the British troops and interpreter there. They tell us they will make their own way back—on foot, we suppose. As our helicopter lifts off, a large cloud of snow envelops the people on the ground, and they wrap their arms about their heads and turn their backs toward us. It is hard to imagine how these two old people have survived up here for this long.

At 2:45 p.m. the crew and I arrive back at the Canadian camp for another hot refuel. By 3:30 p.m. we are orbiting over a Serbian funeral that will last an hour and a half. Our job is to discourage any violence from erupting during the ceremony. Two days earlier, an Albanian youth gunned down a Kosovar Serbian father of four walking home in the late afternoon.

*A bombed-out smelting plant, one of Europe's largest producers of nickel, awaits reconstruction—and the return of displaced workers.*



JONATHAN KNAUL



CANADIAN ARMED FORCES PHOTOGRAPHY LIBRARY

The murder was allegedly carried out as one of many acts of reprisal. Hate comes from all sides.

The rotor blades make a loud slapping noise as I bank the helicopter sharply into the wind and my thoughts veer with it. I focus on the grief that the family below must feel. Added to their pain, they must endure the intrusion of a noisy helicopter as the life of a father and husband is honored and they bid him farewell.

Our flying day finishes shortly after 5 p.m. Canadian Forces flying rules state that aircrews are allowed a maximum eight hours of flying in one day—exactly what we have flown. We must have had at least two false missile-warning alarms every hour. As I lumber out of the cockpit, I feel five pounds lighter than I did when I started my day. Stéphane and Alain also emerge slowly and with much effort, the fatigue visible as they stretch their backs. Many of my muscles are tight, and I am thinking only of a hot meal and bed. Luckily, we are changing to night flying the following day, and can sleep in the next morning. We don't know it now, but we will need the extra sleep for tomorrow night's mission.

**I**t is snowing again, but at least the generator keeps working and there is ample heat in my shelter. After a good seven hours of rest, I am up and busying myself with plans for the upcoming weekly meeting of the First Kosovar Scouts. Several of us Canadian servicemen and -women act as scout leaders for a group of 21 Koso-





**WE PASS A MASS GRAVE** JUST OUTSIDE POKLEK, SHEREMET'S VILLAGE. IT IS THE FIRST TIME THAT I HAVE SEEN A MASS GRAVE UP CLOSE. I HAVE SEEN MANY FROM THE AIR, BUT IT IS VERY DIFFERENT WHEN YOU CAN REACH OUT AND TOUCH THE GRAVES. THIS PARTICULAR GRAVE IS LOCATED ON A BACK ROAD BEHIND POKLEK IN A REMOTE LOCATION WHERE NO ONE WOULD EVER HEAR THE SHOTS.

var Albanian boys and girls, who range in age from 10 to 17. Once a week for two hours, the group meets in the Canadian camp, where we teach the kids everything from orienteering and building a camp fire to dental hygiene and landmine awareness.

Working with the scouts is the easiest part of my job in Kosovo. The kids are always happy, upbeat, full of vigor, and ready to tackle any challenge—not what you would expect from a group of kids who have just been through war and organized persecution. Many of their fathers or brothers are either dead or unaccounted for.

Most of the children have badly decayed teeth. The dentists in Kosovo usually leave rotting teeth in rather than pull them. They reason that it is better to have a rotten tooth than no tooth at all. I take Sheremet, a boy of 14, to see our Canadian Forces dentist one day. There is no choice but to pull one molar that has been causing him a lot of pain. Afterward, I drive Sheremet home in one of our military vehicles. It's a 30-minute drive down a road full of very large potholes—scars of war.

On the way we pass a mass grave just outside Poklek, Sheremet's village. It is the first time that I have seen a mass grave up close. I have seen many from the air, but it is very different when you can reach out and touch the graves. This particular grave is located on a back road behind Poklek in a remote location where no one would ever hear the shots. There are dozens of bodies at the site, all ex-

humed and examined by UN war crimes investigators. After the investigation was complete, the bodies were laid to rest in separate burial plots. This was the 11th mass grave that I'd seen in four months.

When I arrive at Sheremet's home, his family immediately invites me and my driver, Corporal Carlo Senegal, into their home. A single 30-foot-square room, which Sheremet and seven members of his family must share, serves all of them as bedroom,

guest room, and kitchen.

While we sit and speak to his father in French, Sheremet's older sister quietly pours coffee from a golden metal decanter into small cups that hold no more than a couple of ounces. But then, with this coffee, two ounces is more than enough. It is closer in texture to maple syrup than to what we know as coffee in North America. The coffee is very sweet, the taste is pleasant, and it warms me.

*Mounted on the belly and above the windshield, cable cutters are raked forward so power lines meet sharp blades before they can entangle the rotor.*



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*Close—and noisy—observation of events like this organized protest march is designed to prevent violence.*

The room is cool and damp, and Sheremet's father offers to light the woodstove. I decline, having noticed that there was no wood stored outside the house. After half an hour, Carlo and I prepare to leave. Sheremet's father invites us to stay for supper, but they have little food, and we politely decline the offer. I also have a night mission that takes off in less than three hours.

**S**hortly after 7:30 p.m., Stéphane, Alain, and I are flying toward a map grid reference—the only information we have—where we are to pick up four members of a Swedish reconnaissance section. From the map, we can see that the landing zone lies in a narrow valley close to the border with Serbia. To add to the difficulty of the mission, it is a cloudy, snowy night

with limited visibility in a region that is very mountainous. In these conditions, the performance of our night-vision goggles, which amplify ambient light, is significantly diminished. Canadian Forces rules allow us to fly when the visibility is as low as one nautical mile (a bit more than a statute mile) if we can remain 200 feet above the highest obstacle. Flying at the edge of our weather limits with a fuzzy picture through the goggles is very uncomfortable, like driving down the highway in a downpour. To get to the pickup zone, we have to wind through valleys to avoid the overcast, which is pierced only by mountaintops. It is important that we complete this mission. It is another sub-zero night, and the Swedish patrol will have to spend it outdoors in a high-threat area if we don't pick them up.

Arriving in the vicinity of the grid reference, we see two flashes through the murk from a handheld light, indicating the exact location for pickup. There are no other lights available to wave us in; we are close to the border and the helicopter must remain blacked out, as must the people below. We circle once to get a good look at the landing zone. I can see that the LZ is in a tight spot. In the narrow valley, and with the strong winds prevailing from the north, there is only one option for the approach—from the south. We will have to fly over some electrical lines, and there are also lines on the left of the LZ and trees on the right. There will be no room for error, as there is just enough space in the LZ to fit one helicopter. I confirm the location with Stéphane and Alain and give an abbreviated briefing on how I will fly the

## FEELING THE URGENCY

TO DEPART, I YANK THE HELICOPTER OFF THE GROUND. INSTANTLY OUR AIRCRAFT IS SMOTHERED IN SNOW AND ALL THREE OF US LOSE SIGHT OF THE GROUND. THERE IS ONLY ONE OPTION AND SO OUR EYES IMMEDIATELY TRANSITION TO THE INSTRUMENTS TO KEEP THE HELICOPTER LEVEL AND CLIMBING...



approach. Stéphane gives me some tips; he has much more experience than I do.

Stéphane keeps his hands close to the controls as I make the approach. If I lose battery power to my goggles, I will be blind and he'll have to take over. A hundred feet high and 300 feet away from the landing zone, the approach looks good, but I start to feel the embrace of the valley around me. Alain has the back door on my side open and his head is outside the aircraft. I can hear his voice shiver as he reports our proximity to obstacles. A soldier in a clearing is signaling to us with his hands, but I am barely able to make him out. Stéphane continues to coach me through the approach. Thirty feet high and 30 feet away from the LZ, the downwash from the rotors engulfs us in a thick, blinding snow cloud. Alain is still able to see the ground, but I lose all outside visual references. I immediately inform Stéphane, who still has the ground in sight on his side of the helicopter. Stéphane takes over and plants us firmly in the near-knee-high snow.

The four Swedish soldiers jump aboard our aircraft, each carrying a backpack weighing about 80 pounds. With the snow and added weight, the takeoff will be even trickier than the landing. We are tight on fuel, close to the Serbian border, and we cannot linger on the ground. Alain calls "Ready" and I commence the takeoff. Feeling the urgency to depart, I yank the helicopter off the ground. Instantly our aircraft is smothered in snow and all three of us lose sight of the ground. There is only one option, so our eyes immedi-



JONATHAN KNAUL

*Norwegian troops (in the rearmost rank) took over sponsorship of the First Kosovar Scouts, local school-age kids, when the Canadians returned home.*

ately go to the instruments to keep the helicopter level and climbing—a tough transition to make rapidly when you have been looking outside for the past hour. The troops in the back are oblivious to all this; they're just happy to be in a warm place. My fingers tense as I imagine the wires to the left of me and the trees to the right, which I can no longer see. Alain is unable to keep his head outside the aircraft because of the intense blowing snow. The seconds feel like hours, and a sense of frustration washes over me. I want to see outside and be reassured that we're clear of the obstacles. Finally we break out of the snow cloud and find our aircraft in a safe climb out of the valley.

We still have to weave through more valleys to clear the clouds on our way home. Mindful that valleys are ideal places to hit electrical wires, my eyes strain to detect surprises. We are also low on fuel, and the doors start to close around us. Back in Canada this would not be as big a problem—we are in a helicopter and can land in any open field. But this is Kosovo, where there are reported to be more than 20,000 buried mines in the British-Canadian area of responsibility alone. Stéphane knows how to work the fuel-remaining numbers, and minutes later we break out of the mountains and into the lights of Pristina. We drop off our passengers at the Swedish camp on the outskirts of the capital. The weather is much improved between here and

the Canadian camp, and we have enough fuel to make it back with a safe reserve.

Back at the Canadian camp we hover-taxi to our parking spot and shut down. Three technicians drive up, bundled in so many layers of clothing that they look like astronauts on a spacewalk. I watch them hook up a tow bar and jack the skids up on trolleys, their reddened and numb fingers desperately trying to work on the stubborn metal parts in the cold. The ground crew are wizards, and I owe them a lot. During a six-month period, they kept at least six of our eight aircraft serviceable every day.

In the distance, I can see Corporal Bill Street walking the helicopter line. Street is a military policeman with a wife and young child back in Winnipeg, Manitoba. He's part of the Canadian Airfield Security Force, and his job for an entire six-month tour is to pull 12-hour shifts guarding our helicopters and the airfield.

I will fly more missions tomorrow, and Bill Street will be out here again all night, shivering and protecting my helicopter. My mother will be warm in her Toronto apartment, worried sick. But I get my comfort throughout this time in Kosovo from the pride I feel in being a peacekeeper and a Canadian.

*Captain Jonathan Knaul returned from Kosovo in June 2000 and continues to serve as a pilot with his unit based at Valcartier, Quebec. —*



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*Lockheed P-38. Standing directly in front of it reminds me that in World War II, and in the fields like this,*

# Beat Up *ana*



by JOHN FLEISCHMAN

PHOTOGRAPHS by ERIC LONG

and MARK AVINO

I wait quietly by the door while Ed Mautner fishes for the light switch. Already in the dimness I can see wonderful things.

When the overheads flicker on, I am surrounded by legends: early jets, high-altitude reconnaissance birds, weird one-of-a-kind prototypes, airplanes touched by history, airplanes untouched by history, oddballs, old favorites. And these airplanes are real, just as real as time, war, and luck have left them—busted wing fabric, “oil canned” sheet metal, looted instrument panels, rotten rubber, fogged plexiglass, exploded seat cushions, and peeling layers of paint. Most museums show old airplanes buffed and polished as if they were fresh out of the box. But this isn’t a museum, exactly.

We are at the semi-legendary Paul E. Garber Preservation, Restoration and Storage Facility, a cluster of charmless government warehouses east of Washington, D.C., in the town of Suitland, Maryland. This warehouse and the others that Mautner and I are exploring mostly contain airplanes that the Smithsonian’s National Air and Space Museum can’t currently display or that are too rough to show, too large to assemble, or too minor to command display space at the building on the Mall.

Over here is a World War I Curtiss Jenny turned tobacco brown by time but still all there—tombstone-shaped radiator, box kite wings, and those half-circle wing skids that barnstorming wingwalkers couldn’t resist. And that, of course, is a Lockheed P-38 Lightning fighter:

There’s the goofy nose, the twin boom tail, and the long, tall stalk of the nose wheel, which reminds me of a heron waiting for dinner to swim past. Across the aisle there’s a great bruiser of a Grumman TBF Avenger torpedo bomber, with its immense propeller and chunky ball turret.

Most of these aircraft had their heyday well before my time, but still I would know them anywhere. I shared my boyhood bedroom with these airplanes, all in plastic, modeled in 1/72 scale. My fingerprints were all over them, preserved in glue on the “clear” canopies or smeared into the paint job because I couldn’t wait for the wings to dry. I had to touch them, had to hold them up at arm’s length and half-close my eyes and slowly twirl around, deploying them on imaginary missions of great danger and daring.

Sometimes, inadvertently, it was my mother’s dusting that launched them. It was heartbreaking to see my childish craftsmanship smashed, but secretly I had to admit: Crashing improved them. At the ends of their plastic lives, propeller blades gone, gun barrels snapped short, and landing gear lost, their true characters emerged more clearly. The Zero showed its Zero-ness; the Flying Fortress was a stout citadel with wings.

The Garber facility is the full-size equivalent of a kid’s bedroom filled with bashed-up models, propellers snapped off, paint smeared. And that’s why I’ve come here. I have this theory that hard use reveals true character. I expect that, like the stripped-down model airplanes of my youth, these battered survivors will shine more brightly through dirt and damage.

The Garber facility was never intended to showcase old aircraft. It was barely intended at all. In 1947, its namesake, Paul Garber, was made the nominal head of a theoretical National Air Museum. The Smithsonian already had some historic aircraft, but the core of the future museum was to be drawn from a collection of Axis and Allied aircraft that General Hap Arnold of the U.S. Army Air Forces had acquired during World War II. The collection was stored at an unused factory at Park Ridge, outside Chicago, and Arnold promised that once the military had wrung out the last secret of the Axis aircraft, he’d donate the whole shebang to the Smithsonian and to an Air Force museum. When the Korean War erupted in 1950, the Air Force decided to use the Park Ridge facility for producing aircraft, and ordered the Smithsonian to remove the aircraft stored there.

Garber managed to spirit away around 100 airplanes, both Allied and Axis, to a federal tract of land at Suitland. The rest went for scrap (a memory that today causes aviation historians to wince). The ones that made it to Suitland were not all that better off. They were delivered rough and fast, wings unbolted, instrument panels plucked clean, some on storage stands, some on their own wobbly wheels. With no real budget, Garber could do little more than park his treasures in unheated warehouses or right out in the open.

The years passed. Trees grew up right through the old warbirds. Snakes nested in cockpits. Mice flourished in gun turrets. Peace came. War came again.

A small group of employees detailed to the site did what

IN PRAISE OF THE  
WELL-WORN AIRPLANE

# Beautiful





the first Lightning with “chin” intercooler ducts under the spinners. Still in its Army Air Forces colors, this one looks as if it had landed at Garber on a direct flight from 1945.

I’d always thought Lightnings were exotic creatures, high-strung thoroughbreds, but this example stands here dutifully, like an old cavalry nag in its stall. Maybe that’s appropriate: Lightnings fought like cavalry nags, lumbering along over both the European and the Pacific theaters as bomber escorts, their twin engines reassuring pilots that they would make it back to the barn. Lightnings were the perfect mount for a fight far from home, ready to take a pounding and return it, doubled. With their turbo superchargers and counter-rotating propellers, P-38s were remarkably complex machines for their time, but this forgotten Model J reminds me that World War II was a time when frontline fighters lived in fields like horses. The old fighter looks as if it would be perfectly at home on a strip hacked out of the New Guinea jungle or scraped into a Sicilian pasture.

In fact, this Model J survived precisely because it never had to

*Sikorsky XR-5: “Its bulbous nose bubble gives the elderly helicopter the look of a praying mantis.”*

preservation they could. And the facility began offering small group tours. It was catch-as-catch-can tourism; you never knew exactly what would be accessible. Over here: the *Enola Gay*, the B-29 that dropped the bomb on Hiroshima. Over there: a Platt-LePage XR-1, an early helicopter that some consider the ugliest aircraft ever flown. Until recently, the warehouses were either hot and steamy or cold and wet. The insect and rodent life was bountiful. Visitors never seemed to mind.

Eventually, a National Air and Space Museum was funded. For the 1976 opening of the new building on the Mall, Garber’s best airplanes were spruced up and sent downtown. The aircraft left behind were sorted into the immediately restorable, the restorable later, and the hard cases. I’d come to see the hard cases.

Ed Mautner is the ideal companion for my tour. In mid-life he went from auto racing to aerospace manufacturing to training in museum studies. Three years ago Mautner left Southern California to accept an offer from the Garber facility to become a jack of all the strange trades required for working on antique aircraft. He prefaces our tour with a disclaimer: He is just one of the guys in the trenches, and nothing he says here reflects the official opinions, plans, or intentions of NASM or any other federal agency, etc., etc. Understood.

We settle into a game of “What do you do with this airplane?” It’s a game with no right answer; as NASM collections chief Tom Alison says: “If you have 10 aircraft preservationists or conservationists in one room, you’ll have 10 philosophies.”

We start with the P-38—a J model,

endure such hardship posts. “It was never in combat. It was always Stateside,” Mautner says of the Garber specimen. Manufactured fairly late in the war, it was assigned to serve as a home-front trainer and squadron hack.

The truth about World War II airplanes, Mautner explains, is that the ones used in combat rarely survived. Even when their distinguished pilots or crews were sent home to retrain or to sell war bonds, famous craft were usually left behind for other squadrons to commandeer or plunder for parts. The “warbirds” that survived to our time are more often like this one, Stateside trainers and other stay-behinds. This example has no guns, no distinctive fighter squadron markings, no personalized war paint. It’s a drab, brown shoe, government issue airplane.



"If we'd been preparing this airplane in the 1970s for the new Air and Space Museum," says Mautner, "we might have painted it up like Dick Bong's *Marge* or Tommy McGuire's *Pudgy* [the former pilot shot down 40 Japanese airplanes, a U.S. war record; the latter, 38]. We'd have stripped all that off and painted it up with standard olive drab. It would have been a soup-to-nuts restoration and it would have knocked your socks off. Today, the philosophy is 'Hey, this aircraft was never *Marge*; it was never *Pudgy*. While it's never been in combat, it's a very good example of a P-38J.' And it has its original paint, so my thinking would be to clean it up and do some touch up, especially in the cockpit, but basically, wash it and display it."

Increasingly, aircraft restoration is about restraint. Consider two of Garber's World War I biplanes: the tobacco brown Curtiss Jenny JN-4D and a Caudron G-4, a two-engine bomber that France sent to the U.S. War Department for testing, though the armistice left it high and dry. The War Department turned over both airplanes to the Smithsonian, and in 1919 they were hoisted to the ceiling of the Arts and Industries building on the Mall. Eventually, both craft were lowered to the ground and sent to Garber—the Caudron in the 1960s

and the Jenny in the early 1970s.

Back then, restorers might well have stripped the faded and brittle biplanes' original wing fabric, sanded the original wood struts clean of the original shellac, and redone the paint jobs in blazing color. Today that would be considered too aggressive. "We're not just trying to save the shape or the appearance of the object," says Mautner. "What we're trying to save is the technology of what went on there. How did they finish their aircraft? What type of varnishes? What type of shellac?"

Curators are also interested in how aircraft were repaired. In the early days of aviation, when wing fabric developed holes, they were commonly patched. So for the Jenny, an authentic-looking patch job would be part of a historically accurate restoration. That, plus a gentle wash and a coat of protective wax, is all that Mautner would recommend.

The Caudron, one of only two G-4s left in the world, is in worse shape: Workmen readying the craft for its first display punched holes in its wings, and perforated oil tanks in the engine nacelles. The line to follow here, suggests Mautner, is to save everything old for future study, make sure the curatorial file documents every new thing added, and make any new work reversible.

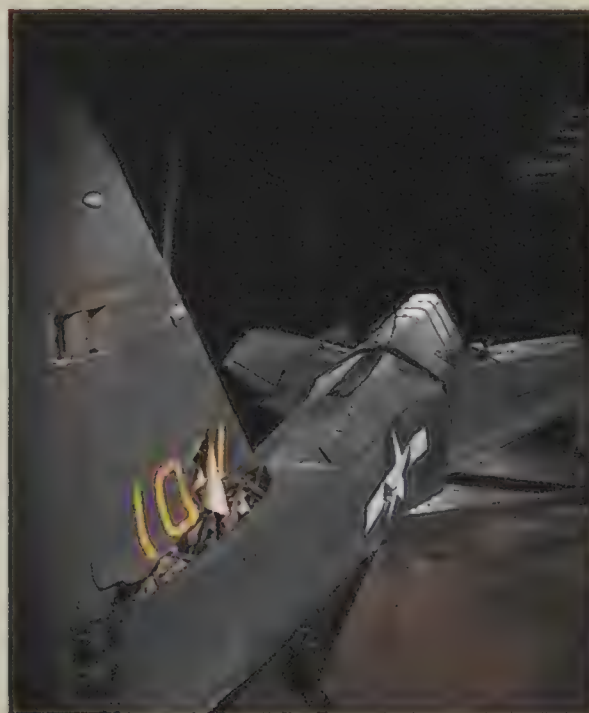
We move on to the Sikorsky XR-5, a helicopter with tandem seating and a bulbous nose bubble that gives it the look of a praying mantis. This was the prototype of what later became the S-51 and the R-5; serving in the Korean War, these were the first helicopters that the military operated in any numbers. The XR-5's biggest cosmetic problem is that its plexiglass is cracked and hazed. The cracked panel would have to be replaced, but "this stuff," says Mautner, tapping an example of the hazing, which makes the elderly helicopter look like it has a cataract, "will polish right out."

Wear and tear like that usually reflects nothing more than routine operation. But what should you do when the damage has historic significance? "Let's say we could go back and get the Red Baron's triplane that he crashed in when he was killed," says Mautner. "Do you repair it and set it up the way it probably looked before the crash, or do you display it *as a crash*?" The choice is not farfetched. Some European museums display wrecks in settings that carefully re-create how the aircraft were found in deep jungle or even underwater. Showing off an airplane in all its battered beauty can serve as an eloquent lesson in aviation history.

*Curtiss Jenny: "Still all there with its tombstone-shaped radiator, box-kite wings, and half-circle wing skids."*

*Platt-LePage NR-1: "An early helicopter that some consider the ugliest aircraft ever flown."*

*Focke Wulf Fu 152: "On its lid, the many layers of paint—red ones, pale ones—bleed into one another."*







*Messerschmitt Me 410: "From my childhood model-making days, I'd know its sinister eyes anywhere."*



*Caudron G-4: For an early museum display of this French World War I bomber, workmen punched holes in its wings.*

At a museum like NASM, though, many visitors come expecting to see aircraft as they once appeared; they would be disappointed by displays that centered on impeccably preserved wrecks. "We are caught here between a mandate to preserve and an ethical obligation to exhibit," says Mautner.

On the other hand, you don't want to improve the past, "preserving" something that never existed: a Japanese kamikaze plane shored up with composite materials, say, or a 1918 Jenny with wings recovered in polyester. That philosophy is exemplified at Garber by a recently completed restoration project, the world's only surviving Aichi Seiran (see "The Japanese Connection," p. 20). The Seiran is a strange Imperial Japanese floatplane bomber that was designed to fold up and be stuffed in a huge "floating hangar" submarine. The idea was for the sub to surface off the coast of Panama, unpack its three folding bombers,

and launch them at the unsuspecting canal. In the war's final weeks, two carrier submarines were deployed, although their only attempt to mount a Seiran attack against the U.S. fleet ended in pilot confusion, the scuttling of the aircraft, and the eventual capture of the subs.

Mautner tells me that in the course of replacing corroded float panels, the Garber restorers occasionally "toe-nailed" a rivet—accidentally set it at an improper angle. Instead of drilling them out and replacing them, the workers left them, as they matched many of the rivets in the original panels. The craft was built in 1945, riveted together by teenagers, women, and elderly men working with lousy tools, bad materials, and little training. "This is part of what you want to tell people about the social conditions in Japan at the end of the World War II," says Mautner.

In rivets, you can see the fate of warring nations. Compare the Seiran's botched rivets, says



Mautner, to those in the B-29 *Enola Gay*. That bomber was built at roughly the same time as the Seiran but a world away, by well-equipped Boeing workers being watched by well-trained Boeing inspectors, all of whom went home between shifts to unbombed beds in Seattle or Wichita. The B-29 rivets are a work of industrial art.

To continue our comparison, we check out one of Germany's "wonder weapons," the Gotha Go 229 twin-jet fighter, which the Allies captured at the Gotha factory in 1945. "I think they built two of these twin-jet versions," says Mautner. "One crashed and we have the other one." The craft is a striking mix of high tech and low: On the one hand, the flying wing was far ahead of similar designs by other nations; on the other hand, because Gotha made the airplane in 1945, when Germany was crippled by the war, it had to use plywood for the wing surfaces; today, those are badly delaminated.

We head for the warehouse that holds a Focke Wulf Ta 152, which was to be Germany's answer to expected B-29 raids. A high-altitude interceptor with a monster supercharged Jumo inline engine, the Ta 152 was an Fw 190 on steroids.



*Sikorsky JRS-1, military version of the S-42: "Unfortunately, its wounds do not come from its one brush with history."*

The airplane is actually a hybrid: a metal Fw 190 fuselage from the nose to behind the cockpit, and wood beyond that. "It was an awesome airplane," Mautner says. "We had the American test pilot here who evaluated it after the war. He said it was one of the best late-war fighters he'd ever flown."

Mautner opens a small service hatch in the swastika-adorned tail. To construct the wooden sections, Focke Wulf brought in cabinetmakers, who lengthened the fuselage to position the control surfaces farther back. Even though the work was done in the final months of the Third Reich, it is beautiful—what you'd expect to find on a desk, not a warplane.

I step back to study the tail. There are so many layers of paint—real

ones, fakes ones—they bleed into one another, an effect that in old masters' paintings is called *pentimento*. The most visible swastika, says Mautner, is a fake, probably painted on by U.S. ground crews caring for Arnold's collection. Displaying the craft in this shape would not help museum visitors learn what a German fighter looked like. I suddenly see the limits of my "battered is better" philosophy. Sometimes battered is just botched.

Restoration, on the other hand, can be a hall of mirrors. Just when you think you know which way is in and which way out, the situation changes. Garber has a North American F-100 Super Sabre that served in Vietnam and later was flown by the Michigan Air National Guard. The aircraft is in decent

condition; all the museum plans to do is remove its post-Vietnam modifications, sand off the Air Guard tail markings, and repaint the Vietnam-era markings. But what if another F-100 turns up, one in worse condition but with a more historically significant combat record? Which would be better to restore and display?

We move on to another curatorial dilemma: Garber's Grumman TBF-1 Avenger—a big, slow, homely torpedo bomber. Mautner walks around to point out an observer's blister that was built into the side at the Grumman plant. It's found only on the Avengers that the United States supplied to the British for their Fleet Air Arm. The aircraft's provenance is largely unknown, but this much is clear: It was indeed built

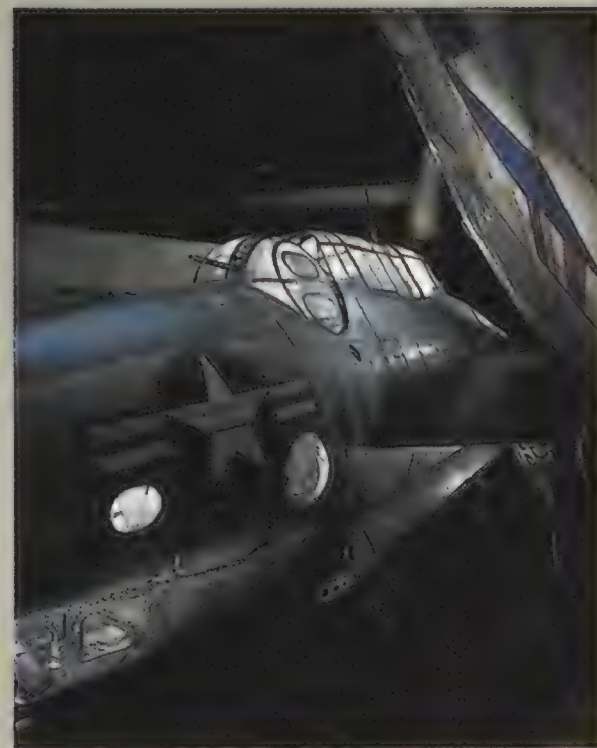




*"Most museums about old airplanes assembled, buffed, and polished. But Garber isn't a museum, exactly."*



*Heinkel 219: This Luftwaffe night fighter was the first service aircraft in the world to get ejection seats.*



*Grumman TBF-1 Avenger: "A big, homely torpedo bomber with two different wings, neither one correct."*

for the British, who called the variant the Tarpon I; it never saw combat; and it was eventually sent to the U.S. Navy, either during the war or soon after. Somewhere along the way, the original wings were replaced with wings from two different Avengers; neither is correct for this variant. The nose gun mounts are original, but the troughs—the notches they poked out of—have been faired over. As for the paint job, it is a peeling mess. When I put my head close to the metal and sight along the fuselage, I can see the ghosts of two sets of U.S. stars-and-bars, plus remnants of what appears to be a British roundel. All of these markings were accurate at various times, reflecting the aircraft's different roles over the years. So which identity should the airplane be restored to?

"In the past," says Mautner, "there was a tendency to refinish an aircraft in the way you wanted it to look, and the temptation here would be to make it look like President Bush's airplane. The temptation would be to remove this"—he pats the observer's blister—"and make it into an American version, but I think that's something we're getting away from. There's an element of dishonesty involved because no matter how many placards you put up around it, there will be people who walk in and say, 'Oh, that's George Bush's airplane!'" (I am reminded of my model building days, when each kit's

identity was truly plastic: You could paint your aircraft into different nationalities or production models.)

Yet another restoration dilemma: a JRS-1, a military version of the Sikorsky S-42 twin-engine flying boat. Sikorsky built some famous flying boats, but the S-42 is not one of them. So what's this one doing here? Back on December 7, 1941, it was part of the U.S. Navy fleet, stationed at Pearl Harbor. Shortly after the attack it was sent out to find the Japanese fleet, and it came back in one piece. It was one of the few large aircraft that was airworthy after the Japanese had come through.

Even by Garber standards, the JRS-1 is in terrible condition: the fuselage a riot of markings and dents, the wing fabric in tatters, the interior stripped to bare bones. Unfortunately, the wounds do not come from its brush with history, but rather from long, hard use during the remainder of its wartime service, and its many years of storage at Garber. I can make out the ghosts of three or perhaps even four sets of U.S. markings. For the curators, the question is: Will careful sanding reveal the original colors and markings, or will the JRS-1 have to be repainted to reflect its 15 minutes of fame at Pearl Harbor? The answer will have to wait until a team is detailed to give the JRS-1 a new life as a museum exhibit. Someday...

As for today, it turns out to be the perfect moment to visit Garber. The place is doomed. The whole operation—collection, restoration shops, offices, and hard cases—is scheduled to move in 2003 to a new NASM museum at Dulles airport in northern Virginia—the Steven F. Udvar-Hazy Center. The center will provide the room for famous air- and spacecraft that were too large to exhibit in their entirety, like the *Enola Gay* and the Martin B-26 *Flak Bait*, plus much of the Garber collection.

The Dulles operation will be bigger, cleaner, and far more accessible, but some will miss the old Garber. I understand that.

Here, in these gloriously cluttered backrooms, I come across the faces I'd learned in plastic as a boy: the chubby nose of a DC-3, the sinister eyes of a Messerschmitt Me 410, the blunt snout of a Northrop P-61 Black Widow. Despite the ravages of time and weather and use and neglect, I recognized them immediately.

And this is how so many veteran pilots, regardless of which war they fought in, remember the aircraft of their youths. So says Mautner, who has noticed them touring the warehouses and watched them grow silent at the sight of a banged-up machine, hunkering in bad light. Back in the South Pacific or Korea or "in country," as the veterans say, this is how our squadron really looked. ✈





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# test





# drivers



Behind the glamour boys in X-planes is an entire profession making sure your Cessna has its wings on straight.

by D.C. Agle

**T**est pilot Bill Vavra is doing what test pilots do—hurtling across the sky in his company's newest carbon-fiber screamer. In front of him, beyond the EFIS, IAPS, and several other acronyms associated with such high-flying enterprises, is a nine-foot nose-mounted boom filled with sensors connected to gauges. Behind him sits an instrument bay loaded with the latest in electronic tell-me-how-I'm-doing hardware. And to his right, just beyond the switch-laden center console and the throttle quadrant, is a reporter looking for something...well, something test-piloty.

"Let me think about that one," Vavra says as he casually demonstrates the engine-out performance of this experimental Raytheon prototype—the Premier-I, a seven-passenger, 530-mph business jet—high over the winter wheat of south Wichita. "There was this one time when during this one test flight that I had this one problem..."

Vavra, a six-year Air Force veteran with well over 17,000 hours in high-performance jets under his Nomex belt, tells his tale of a general aviation flight test "near thing": "We were returning from a test flight with a brand-new airplane and I couldn't lower the landing gear, which, as you know, makes for poor taxiing qualities. So I told the tow-

er we needed to look at the situation and flew off to a practice area."

Kicking into a civilian approximation of Right Stuff mode, Vavra and his flight test engineer began furiously digging through manuals and assessing the situation. Suddenly, the gear popped out. That is pretty much the whole story. No dramatic maneuvering, no foamed runway and meat wagons lined up along the landing threshold. Nothing too test-piloty there.

"Sorry," Vavra says. "But this is gen-

eral aviation flight test. Not Hollywood flight test."

Maybe Hollywood did exaggerate the danger and glamour of flight test a little with Clark Gable, seen running daringly in and out of luck and Myrna Loy's arms in 1938's *Test Pilot*. In that film, co-star Spencer Tracy upbraids the wide-eyed ingenue Loy: "You little fool! Don't you know it is even dangerous to *look* at an airplane?" But soon life imitated art. Think of Chuck Yeager pushing his X-1 past the sound bar-

*A planeload of electronics accompanies test pilots, like Bill Vavra aboard Raytheon's Premier-I prototype (opposite). Mort Brown logged 18,000 first flights (top), a number Frank Martinelli (below) might someday surpass.*



CAMERON DAVIDSON





*Taking no chances with an untried aircraft, freelance test pilot Mike Preston conducts a meticulous presflight of Piper's new Meridian turboprop.*

rier in 1947, or the X-15 pilots toying with the edge of space in the 1960s, or any of today's test pilots throwing fresh-off-the-drawing-board fighter jets around the sky above Edwards Air Force Base.

That's not general aviation flight test, and it's doubtful that a Hollywood producer would ever come looking for Bill Vavra or, even less likely, production test pilot Barton Jones.

"I have a wife and two boys ages nine and eight," the 42-year-old Jones says. "We are active in Cub Scouts and camping and fishing, and that is the way I like it. I do not want to give up flying but I want a normal family life also."

Jones tests factory-fresh aircraft for New Piper in sunny Vero Beach, Florida. It is a career the former aircraft mechanic and agricultural and corporate pilot will be the first to tell you is not exceptionally glamorous. "When I tell someone what I do, they think of the Gary Cooper type, silk scarf and all," Jones says. "But that type would cost you too much money. What you really want is some guy who has five kids and a mortgage. We are not paid to take chances with someone else's aircraft. We are paid to bring them home in one piece."

Production flight test is the most humdrum outpost of the flight test profession. Just as every car rolling off the production line is examined by someone with a keen eye for flaws, and each pair of Fruit of the Looms is perused by Inspector 12, every virgin airframe that rolls out of the factory doors is put under the microscope—both on

the ground and in the air—by a production test pilot. It is not always as easy. Even with the advantages of computer-aided design and advanced manufacturing techniques, each airframe is still made by, and every altimeter still bolted in by, a human being—a thought never very far from a production test pilot's mind. "There is a certain excitement when you are out there and taxiing into position in an aircraft that has never flown before," explains Frank Martinelli, manager of New Piper's production flight test program. "You hear the horror stories of aileron control chains coming off during first flights, tools left in the fuselage, and stuff like that. But mostly you just hear of them because it happens so infrequently."

Perhaps the biggest danger these pilots face is not their untested aircraft but their environment. Piper's test pilots ply their trade in one of the busiest air corridors in the country, and it is not just the airplanes that get their attention. It's the feathered creatures who enjoy the same south Florida sunshine and at the same altitude as the pilots. "Let me tell you," Martinelli says, "if I ingest a bird or something else happens and I lose the engine, I'd rather put it down in the ocean and take my chances with the sharks than go down in the swamps and deal with one of those gators."

Flying five to seven days a week with an average of five flights per day, production test pilots buzz over a lot of sharks and gators, taking every new airplane to every placarded redline and

every minimum flyable whatever. If a twin-engine Seneca is rated to climb at 1,500 feet per minute, they make sure each one does. If the operating manual of a single-engine Archer says the airplane will stall with the gear down at 48 mph, you can be darn sure a Piper pilot has made sure they all stall at 48 mph. By the time the Federal Aviation Administration grants an airplane type a certificate of airworthiness, one or more of Piper's test pilots will have tested and checked off hundreds of items in a thick Flight Inspection Report. From confirming that the map light works and the trim wheel has no excess friction to making sure the compass is accurate and the cabin defroster is operational, there is no detail too minute for inspection and approval. And with today's general aviation instrument panels looking more like that of a Super Hornet than the one in the *Spirit of St. Louis*, it can take four or more flights to check all the mechanical and electronic gear and get it working as advertised.

Which brings us to 700 bumpy feet over Florida swampland. Little more than 10 minutes ago, Jones was soaring 25,000 feet over the Atlantic making sure maintenance crews had fixed a minor glitch in the pressurization system of a Malibu Mirage, an \$869,000 single-engine turboprop. Now he's taking the airplane down among the gators, water moccasins, and buzzards, going flat-out through turbulent air, doing a test the Flight Inspection Report for Model PA46-350P calls "maximum indicated level flight airspeed." "We run

*New Piper production test pilot Bart Jones leaves the silk scarves to the Hollywood stars, but even real test pilots wear sunglasses.*



CAMERON DAVIDSON (2)





COURTESY MORT BROWN (2)



*Dashing, maybe, but definitely prolific: Mort Brown, shown in his younger days (right) and trying out a Cessna 190 in 1948 (above), owns 24 logbooks—all filled.*

at full power at low altitude to check performance," Jones says. "If you've got good rpm, good fuel flow, and good manifold pressure and you are not flying within a certain known speed range, something is wrong somewhere. Could be airframe-related. A prop could be dragging. Something with a landing gear door. At that point you really do not know what, but you do know you cannot check it off as acceptable."

A production test pilot taking an airplane on its first flight will always be able to find something that can be tweaked. This particular Malibu has been up three times, with mechanics adjusting a list of ailments in between. Now, with the airspeed indicator reading a right-on-the-money 183 knots, Jones makes one final, satisfied squiggle of his pen and closes the book on the last open question about the Malibu. Of the event, Jones offers no memorable words. Not even a high-five. As he steers for home a couple of buzzards zing past our wingtip. Jones just

smiles. "Our competition," he says.

Upon landing, Jones walks away from this three-quarter-million-dollar machine, which he has taken from the cradle to certified-for-delivery. He will likely never fly the airplane again, or even see it. But there are two other Malibus waiting for first flights, a Seneca that needs its global positioning system re-checked, a couple of Archers that need some tweaking, and a factory cranking out more just behind them. It keeps him busy, and it keeps him flying.

As much flying as Jones and Piper's other production test pilots logged—well over 7,000 hours each—they could never come close to the king of production flight test. The king does not live in sunny Vero Beach. He lives in landlocked Wichita, Kansas, and is now retired. And does he have some hangar stories...

"Here is one," the 92-year old Mort Brown begins. "In the '60s we were building the Cessna 337 and they flew

fine. But then they decided to change the wing and I soon noticed handling problems with the planes I was flying."

Brown, at the time Cessna's chief of production test pilots, kept bringing one of the particularly ill-performing twin-tandem-engine 337 Skymasters back from test flights with a bad report card. It was apparently a frustration Cessna's production manager did not need. After all, it was the production manager's job to make certain the "production" made money for the company. Yet here was Brown bringing back an airplane again and again, complaining about its flying characteristics. Finally, the production manager decided to tell Brown what was what, explaining in no uncertain terms that there was not a thing wrong with the 337, that engineering had signed off on the new wing and Brown, as a production test pilot, was obligated to sign off on the airplane. Or perhaps find another line of work.

"So I said, 'Okay, boy, let's go for a



ride,' " Brown recalls. "I got us up to 8,000 feet, and sure enough, when I put it into a gentle stall, we rolled up into a right tight beautiful spin and lost 5,000 feet. Now, this particular manager was a pipe smoker, and when we got back on the ground he couldn't even get the darn thing in his mouth he was shaking so hard."

After Brown's passenger got his mouth and his pipe connected, Cessna engineers took a hard look at the newly modified 337 wing. They found that the new production process being used to get a sharper edge on the wing's leading edge—the rollers would bend the aluminum tighter mid-bend—left a small ridge in the aluminum. While virtually unnoticeable on the ground, in the air the kink induced stalls well above the design airspeed under certain conditions, causing the aircraft to depart from controlled flight. The production process was modified and Brown was vindicated.

For the chief of production test pilots it was a bittersweet victory. Brown was well on his way to an undoubtedly Guinness-worthy 18,000 first flights, and here was a production manager with one eye on the bottom line and the other on Brown, telling him how airplanes flew. "Some people say pro-

duction flight test is a pushover," Brown says. "T'aint so. You want top quality but sometimes the stuff leaving the factory is otherwise. You have got to be able to understand what is not right with an airplane when you first fly it and tell the guys on the ground what needs to be fixed and do so quickly enough so that the company still makes money on the deal."

Every manufacturer of FAA-certified general aviation aircraft has a production flight test department filled with pilots like Brown, Jones, and Martinelli—company pilots who love their jobs because they spend the majority of their time airborne. But each manufacturer also has another flight test department, where pilots spend considerably more time attending meetings and doing paperwork than flying. These guys, too, wouldn't have it any other way.

"It is our job to break airplanes," explains 62-year-old former semi-pro baseball player Mike Preston, who helps coax new aircraft designs into production. "We are supposed to push the airplane as hard and as far as it will go within the bounds of what it is supposed to do." Preston is a freelance test pilot whom Piper is using to bring the new turbine engine Meridian, a

state-of-the-art 300-mph aircraft with a completely digital cockpit, to market. To the FAA, this certification means that almost every performance parameter and every imaginable situation that the most ham-handed, lame-brained of licensed pilots can put this new aircraft in will be explored and described in copious detail.

Preston and his peers at Piper's engineering flight test division are as close to the Hollywood version as you will find in Vero Beach. But after the seventh flight profile, in which you have to hold altitude within five feet and air-speed within half a knot to test cruise performance, the gloss can fade pretty quickly. And then there is dealing with the lesser-mortals thing: "Most people in an aviation company, from the president on down, don't really know what it takes to get an airplane certified," Preston says. "I've been in some meetings where some of these people come up with the dumbest comments and weirdest ideas because they don't understand what it takes."

What it does take to be an experimental test pilot is apparently not so much flying ability as assessment ability. Sure, you have to keep on target with climbs, dives, stalls, and even level flight within certain parameters, but ask any of these guys and he will tell you that most pilots can eventually learn to do that within acceptable levels. What sets them apart is their investigative nature, background in engineering, knowledge of what it takes to get FAA certification, and tolerance for paperwork and more paperwork. "There is an old saying in flight test," Preston says: "An airplane doesn't get off the ground until the paperwork at least equals its gross weight."

While advances in the science of aviation have diluted some of the wild experimentation in experimental test flying, there are still problems that require a certain amount of seat-of-the-pants flying ability. Just this past year, test pilots at both Cessna and Piper were forced to declare in-flight emergencies and land their experimental prototypes on highways.

And experimental flights can have even more dire consequences. In 1980, Canadair's new Challenger corporate jet prototype crashed, killing its chief

*Piper's production flight test pilots (below) begin another day of earning their badges.*



CAMERON DAVIDSON (2)



test pilot, after an angle-of-attack indicator malfunctioned and the airplane stalled (another malfunction kept a temporarily-deployed "spin chute" from separating from the aircraft after being engaged). In the course of testing its single-engine composite design over the years, relative newcomer Cirrus Design Corporation has experienced several crashes, resulting in the deaths of three test pilots, including former military test pilot and NASA astronaut Robert Overmyer in 1996.

While tragic to the experimental flight test community, hazard is expected from time to time. But experimental test pilots are also sometimes asked to revisit proven general aviation designs that have already passed the certification process and are flown on a daily basis by just plain folks with private or recreational ratings. And these programs can be just as hazardous as any initial flight test program.

"It was in April of 1966, the same week I was selected for the astronaut program," recalls Apollo crew member Fred Haise, now a semi-retired aviation consultant. "This test almost ended my astronaut career before it got started."

Haise was flying as a test pilot for NASA at Edwards Air Force Base in California when a call came in from the FAA. "They asked us to do a program on the Piper Twin Comanche which had a couple of accidents in which the tail came off in flight," he says. For the former fighter pilot, flight test was flight test no matter if the airplane redlined at 190 knots or Mach 2. So he set about planning and flying a series of incrementally faster test flights trying to find out why the Twin Comanche's tails were failing. "I would put it in a dive and when the airspeed stabilized at the number I wanted I would chop the yoke—hit it with my hand trying to induce an unstable series of oscillations that can mean real trouble for an airplane." One day Haise chopped the yoke and the Comanche chopped back. "It was like riding a jackhammer," he says. "I couldn't read the instruments. I couldn't get the controls to respond. But we got good data."

The Comanche's tail failed, but fortunately did not tear off the airplane, and the future lunar module pilot was

able to land the crippled twin on Edwards' dry lake. As a result of Haise's experience, the FAA sent out an airworthiness directive that more than likely saved many lives. "I had a chase plane shooting the whole thing," Haise adds. "The airplane looks like a bird flapping its wings. I understand the Air Force Test Pilot School still uses the footage as part of its curriculum."

Test flights that become case studies for budding test pilots are rare. Usually pilots can spend their time doing what they do best: helping make good airplanes better—and having some fun in the process. Back aboard the mul-

ti-million-dollar Premier-I prototype, Bill Vavra and I are hauling the mail at 17,000 feet when Vavra suddenly turns to me and offers the controls. "Have some fun," he says. "Really wring her out." Soon we are skimming the cloud tops as I do my poor imitation of "really wringing her out." But as no alarm bells are chiming, Vavra leans back in his seat and smiles. "You want to know what the best part of being a test pilot is?" he says. "This is it. We're flying a high-performance jet, having a blast, and there is nobody in back so you don't have to worry about them [dropping] their doughnuts." —

*Under the watchful eye of a T-38 chase plane, Raytheon's Bill Vavra coaxes the Premier-I through test maneuvers on the way to certification.*

PAUL BOWEN







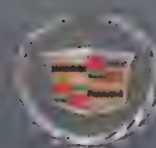
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# HOW TO GET ALONG IN SPACE

by Beth Dickey

Illustrations by David Povilaitis

## NASA HAS STARTED A NEW TRAINING PROGRAM TO HELP SPACE STATION RESIDENTS FIGHT OFF CABIN FEVER.

**T**hick snow blanketed the aspen woods outside Canadian Forces Base Cold Lake in northern Alberta. Being dumped from a helicopter into this desolate and isolated landscape with only a 30-year-old map, a compass, and a tent would unnerve the most cool-headed of astronauts.

Four-time shuttle flier Jim Wetherbee recalls the frigid predicament in which he and five fellow astronauts found themselves last winter: "The sun was going down and we couldn't find a path to get up this hill with this 260-pound toboggan," he says. "There was a lot of pressure on the lead-

er to figure out what to do. It was a classic case where the team started to break down a little bit."

And all Wetherbee could do was stand back and watch. For this drill, the shuttle mission commander was subordinate to a rookie training for a four-month stint aboard the International Space Station. "I was a little bit worried on one hand, but interested to see what the outcome would be on the other," Wetherbee confides. "When we finally got to the campsite and got the tent up, there was a huge sense of accomplishment. It gets really scary when it's 36 degrees below zero."





Three teams of astronauts journeyed to Cold Lake last February and March to learn team dynamics and the finer points of working together. Their teacher: Canada's Ministry of Defence, known for its expertise in winter warfare. In a six-day outing, each team of six donned parkas and mukluks to drag an overloaded toboggan through miles of knee-deep snow. There were occasional blizzard conditions—brisk winds blowing dry snow into opaque curtains of white around the astronauts as they huddled together. They cooked on portable stoves and used primitive latrines. They struck and set up camp several times a day. They per-

formed myriad menial tasks and science experiments. Amid increasing physical demands, they were deprived of sleep. All of it was directed on walkie-talkie by survival experts who lurked nearby and spied on the astronauts with night-vision goggles.

"The idea is for them to learn about themselves and coping methods in confined, stressful situations," says Brian Houlgate, a lieutenant colonel in charge of international programs for the Canadian Aerospace Training Project in Ottawa. The Cold Lake experience is part of a new NASA program designed to emphasize the psychosocial chal-



**"After a month or two, territoriality, withdrawing from each other, not getting along, getting tired of hearing the same old story—all these factors start to build."**



lenges a group must deal with when it is stuck in a harsh environment.

Is the Canadian expedition a decent simulation of spaceflight? Drillmaster Colin Norris suspects so. Says Norris, a winter warfare and survival expert retired from the Canadian army: "I've never been up there, but I have been in an arctic tent, and after about three weeks or so, just the way somebody slurps their pork and beans will drive you up the wall."

**I** have talked with some of the original astronauts," says Nick Kanas, a psychiatrist at the University of California at San Francisco who studies the psychosocial aspects of spaceflight, "and one of them sort of joked and said

to me that 'In my day, our idea of a spaceflight was you go up and you come down in time for cocktails,' and he says he doesn't know how people can go up and stay for months on end in space."

It's a good question. Traditionally, NASA's Johnson Space Center in Houston has focused its training largely on preparing and rehearsing for spacewalks and other mission tasks. From their assignment to a crew until the end of the mission—typically eight months but sometimes as long as two or three years—astronauts work and party together. They share an office and socialize outside it. All this togetherness is supposed to help them work out interpersonal frictions. Usually it works. When it doesn't, they're expected to maintain professional decorum.

"It becomes a different story when missions become four, five, six, seven months," says Kanas. "There are breakdowns I think in people's ability to tolerate psychosocial stresses after the first couple of months." The Russian literature, he says, shows that "there seems to be a period of about a month or two where people can kind of handle anything, but after that the psychological and interpersonal stresses start to build and then the factors about territoriality, withdrawing from each other, not getting along, getting tired of hearing the same old story, displacing tension to the ground—all these factors start to build, and I think become progressively worse over time unless they're dealt with and recognized."

Between 1996 and 1998, U.S. shuttle astronauts got a taste of these long-term stresses when they participated in the Mir-shuttle program, a series of seven missions in which they spent three to six months working with cosmonauts on the Russian space station Mir. NASA used these missions as a bridge to its own future outpost in the sky—the International Space Station. The agency learned efficient ways to deliver supplies and how to train crew members to handle emergencies. But most importantly, from the lengthy missions, collectively known as Phase One of the ISS Program, NASA realized it had underestimated the emotional and social problems that people living in spacecraft for extended periods can experience. John Blaha, for example, suffered deep depression during his first month on Mir. He missed his wife, he felt like a stranger to his crewmates, and he was unhappy that he couldn't vote in the 1996 U.S. presidential election. Jerry Linenger, who followed Blaha, felt profoundly isolated on the station, despite his experiences in the Navy on guided-missile destroyers, submarines, and even a virtually deserted island. Linenger often was at odds with ground controllers, who thought him moody.

NASA assigned Nick Kanas to study the psychosocial experiences of the shuttle-Mir crews. The psychiatrist had each U.S. astronaut fill out a weekly questionnaire rating his or her emotional state, as well as the state of the group as a whole. Kanas and his coworkers are now analyzing the results and starting to quantify the cohesiveness and tensions of the groups.

At the crews' request, Kanas disguised the data just enough to protect identities and keep responses from being associated with specific events. Three major preliminary findings have emerged so far. First, in comparing the



first and second halves of a mission, Kanas saw that while the crew's mental and emotional functioning did deteriorate to some extent, mission duration itself did not seem to significantly affect interpersonal relations. Now, says the researcher, "We're analyzing stressful events that occurred during the missions to see if they're a more powerful predictor of changes in crew tension, cohesion, and leadership than just simply being together for a long period of time."

A second finding involves a phenomenon termed displacement. Just as a couple might blame relatives for problems within their own marriage, space crews who get into emotional tussles with each other might displace their anger toward controllers on the ground. "We found on our measures in both the crew members and people on the ground in mission control that they [the astronauts] tended to displace negative feelings during the particularly stressful times that they had," says Kanas. "Crew-ground communication is very important and if crew members and ground personnel are not understanding each other's feelings...it can lead to distortions in communication and difficulty when, in fact, [the problem] may not even be related to the two [groups] at all."

The third major finding of the shuttle-Mir study was that U.S. and Russian subjects differed from each other in their responses, both in space and on the ground. "In general, Americans seemed to be a little more dysphoric in their work environment," says Kanas. The researchers concluded that the feelings of discontent resulted from the way the crews were combined. "There was one American and two Russians on all of these missions," Kanas says, "and the American was always in the minority, and basically the Americans were flying on a Russian vessel with a Russian commander where the predominant language was Russian, where all the jokes and things were in Russian. And I think the U.S. crew members felt basically socially isolated in that kind of environment."

In addition, he says, "The Americans, both on the ground and in space, felt that they were under more work pressure, significantly more, than the Russians did." That finding could be merely an artifact of language—the Russian wording for "work pressure" may imply something different from what "work pressure" suggests to an American. Or the finding might mean that the Americans really did feel more pressure.

The studies have some flaws. The researchers expected the crews to be passing the time on Mir primarily in boredom and didn't expect them to be subjected to the stresses they experienced, such as the fire that broke out on Mir. "For some of the events that were especially stressful, the crews were so busy—I hate to use the pun of 'putting out a fire'—but were so busy taking care of...whatever happened that they did not fill out the questionnaires," Kanas says. When such busy times occurred, the astronauts would fill out the questionnaire after the incidents, yielding results that weren't as accurate.

Still, even with flaws, Kanas believes his team's study is the first to make significant observations about the psychosocial dimensions of long-term spaceflight.

In the wake of the Mir missions, says chief astronaut Charlie Precourt, "we recognized we were not as prepared as we ought to have been, either from a management standpoint or a crew training standpoint. We saw shortfalls involving crew members' understanding of the personal interactions, which could happen to anybody, even brothers and sisters...."

"We started to look at other [training] models that are out there, like expeditions to Antarctica and the outdoor leadership schools, that would...arm people with the right tools to persevere through the hard times."

The architects of the training regime that NASA is instituting include Precourt and Shannon Lucid, the second as-

"There was one American and two Russians on the Mir-shuttle missions, and the American was always in the minority. It was a Russian vessel with a Russian commander, where the primary language was Russian and all the jokes were Russian, and the U.S. crew members felt socially isolated in that environment."





Nasty surprises pumped up the stress at Cold Lake. Someone's sleeping bag suddenly went missing. An "injured" snowmobiler appeared out of nowhere, screaming for help. Then there were the snow fleas. Lee Morin found them in his coffee one morning. "They look like coffee grounds," he recalls, "until you realize they are climbing up out of the snow and into your food."



tronaut to live aboard Mir. Says Lucid: "Everybody that came back from Mir said what I said: It doesn't make any difference if you have the most high-tech, latest, state-of-the-art equipment. If you don't have a crew that gets along, you'll have a miserable experience."

The training regime begins at the Johnson center with lectures by experts—arctic explorers, astronauts who went to Mir—on leadership and lessons learned. Reading assignments about psychology and polar expeditions supplement the classroom work. Psychologists who understand the explorer's mindset spend time with the astronauts, prompting them to think about their likes and dislikes, strengths and weaknesses, and responses to crisis situations. After that come the field trips: one to Cold Lake and a similar one to the National Outdoor Leadership School in Utah. Then the astronauts return to the Johnson center, where they are isolated in a chamber for a week, with no contact with the outside world. They prepare meals and give themselves sponge baths just as they would on the space station. NASA also sends astronauts to the Star City cosmonaut training center outside Moscow for courses in winter and water survival.

For the Cold Lake portion of the training, it wasn't easy for the astronauts to figure out how to prepare. Participants in the first two sessions were cagey, not wanting to reveal anything to subsequent participants that might spoil the training. "That was sort of unsettling," says Lee Morin. "You got to feeling like you were asking for the secret questions on the test or something."

A total of 18 people—17 astronauts and one flight surgeon-psychiatrist—took part in the training. Each group consisted of a mix of people with and without spaceflight experience. Three people (all rookies) were selected to take turns leading, each for two of the six days. "The three things we need to learn are leadership, followership, and self-maintenance," says Dan Tani, a rookie who participated in the third session. "This is an excellent environment to learn those three things separately and intensively."

Nearly everyone who participated returned to Houston changed—mostly in little ways. When Lee Morin, a microbiologist and former Navy flight surgeon awaiting his first flight assignment, took his turn as leader, he came across as bossy. He interpreted his civilian teammates' behavior as passive-aggressive and they, in turn, wondered what had gotten into him. It wasn't long before he learned to adjust his style to suit the team. "What I needed to do was be tolerant of them being more laid back than I would normally expect from military subordinates," he says.

During his session, Charlie Camarda served as the leader on the last two days. By then everyone was tired, their performance was deteriorating, and they were called on to do an emergency rescue of an "injured" person. The team had to navigate across the frozen lakebed, find out what was wrong, and decide quickly whether to carry the victim back to safety or radio for a helicopter. "You have to be able to make decisions rapidly, size up your crew, and know who's capable to do the job, and that entails monitoring the health of the other crew members," says Camarda. "Is that person rested enough? Can he pull a 260-pound sled two



miles to rescue a person, or should I pick someone else? It's cliché, but the weakest link is the weakest person, and the simplest accident or malady of any of the crew could turn into something major in space as well as at Cold Lake."

Camarda gives the experience high marks for exposing interpersonal friction. "In a very short period of time, you can tell different characteristics and traits of your fellow crew members that, if extrapolated over a period of time, could potentially be very annoying," he says. "They introduced enough tedious work, enough physical labor that you were tired, fatigued. There was sleep deprivation. By four days into the six days you can notice a drop in performance."

Nasty surprises pumped up the stress. Someone's sleeping bag suddenly went missing. An "injured" snowmobiler appeared out of nowhere, screaming for help. Then there were the snow fleas. Lee Morin found them in his campstove coffee one chilly morning in the first week of March. "They look like coffee grounds until you realize they are climbing up out of the snow and into your food," he says. He happened to be carrying an otoscope, an ear probe with a light and a magnifying lens, and when he trained it on the snow fleas, he saw they resemble cockroaches.

As for slow periods, Mike Massimino recalls that his teammates passed the time telling stories about themselves—from childhood to college and the military to how they met their spouses—and getting to know one another better. A movie buff, Massimino kept everyone amused with his *Godfather* monologues. Levity defused conflict.

Massimino says the Cold Lake experience helped him learn some of the finer points of leadership. "Sometimes our tendency might be to not complain that 'I'm feeling crummy,' to not want to bring the group down," he says. "It's important for a leader to notice these things and look for signs. Who needs help? Who needs rest? Who needs to go to the bathroom? Things that sound almost silly are very important out there."

The program is getting mixed reviews. Dan Tani loved the outdoor training. "I haven't been in space, but I really feel like I've been in the environment," says the MIT mechanical engineering grad. "I feel like I won't have to go up the same steep learning curve that other first-timers will."

Of the astronauts who have not gone through the training, some are skeptical. "It's a solution in search of a problem," says one, not wanting to be identified. Others say Cold Lake is the "in thing" to do to curry favors with Johnson Space Center officials who decide on flight assignments.

Patricia Santy, a former NASA flight surgeon and author of *Choosing the Right Stuff: The Psychological Selection of Astronauts and Cosmonauts*, thinks the training is merely a token gesture. "I'm glad that they're finally doing this," she says, "but I suspect it's just this superficial attempt to allay any public criticism by showing [NASA] has some psychological stuff."

**S**ome of the psychosocial problems observed during the Mir missions may not resurface during the ISS missions. With 16 nations participating in the ISS program, Kanas predicts life will be easier than it was on Mir because minority cultures can band together—for example, one Amer-

ican and one Japanese against two Russians. "If you have a lot of people from different backgrounds," the psychiatrist says, "in a way that might make it easier for people not to feel left out."

In addition, Americans will probably feel less alone: English will be one of the major languages spoken on the ISS, and the missions—the early ones at least—will include either a U.S. commander or two U.S. subordinates. And because later missions will have larger crews, the interpersonal dynamics on the ISS may work better than those on Mir. Kanas says it's a well-established finding of social psychology that of groups numbering between two and 11, larger groups tend to do better than smaller ones, and odd-numbered groups tend to do better than even-numbered ones. If you have larger groups, people always can find some kind of an ally so they won't feel isolated. And if you have an odd number, people can get a consensus by voting.

For the ISS missions, Kanas and his team will look at the cultural sophistication and foreign language skills of each crew member in order to learn whether these factors affect group performance. Says Kanas: "We've been getting into ethnic food that they might like, we're looking at their ability to be fluent in a language versus just speak it enough to get by, we're looking for interest in dance of other countries—a number of factors that will hopefully tell us how tolerant each crew member is."

During the ISS missions, both astronauts and mission control will be asked to assess the spacefarers' moods and their group dynamics on a weekly basis, and to keep an incident log. Like the Mir-shuttle study, the ISS study will look for evidence of displacement, and for any changes in tension, cohesion, and leadership that occur between the first half of the mission and the second.

In the International Space Station era and beyond, astronauts will need to possess a different kind of Right Stuff. NASA will continue to need pilots who can keep their cool in the face of danger, but it will also need people who are emotionally and socially equipped to endure the tribulations of long-term space missions. ➤



# Comm

## Why Airline Crashes Aren't Criminal | by

**Airline accidents are usually the result of tragic mistakes, and prosecuting those responsible doesn't benefit anyone.**

When I served as Counselor to the Secretary of Transportation and later as Federal Aviation Administration Chief Counsel in the Bush administration, I was faced with several airline tragedies: a microburst that knocked Delta Flight 191 out of the sky over Dallas, Texas, the USAir/SkyWest controller error at Los Angeles International that resulted in a runway collision, the crash landing of United 232 in Sioux City, Iowa, and the downing of Pan Am 103 by a terrorist bomb.

Pan Am 103 triggered a massive criminal investigation, which everyone hopes will result in the culprits being brought to justice. Unfortunately, the criminal investigation that was so warranted in the terrorist attack on Pan Am has become all too commonplace in today's investigation of airline accidents. Criminal investigations and sanctions in the wake of a major aircraft accident should be reserved for deliberate acts of sabotage. The current criminalization of aviation accidents is not in anyone's best interest.

I reject the notion that criminalizing accidents is necessary for deterrence. Aviation companies and individuals already have abundant ways to deter bad acts. They are in the safety business. Flight crews risk their own lives every day in the flight deck. While they ordinarily exercise great judgment, one lapse of judgment, like failing to declare an emergency or failing to get the airplane down when lights go off or smoke appears in the cockpit, can lead to tragedy. A black mark on your safety record, even undeserved, can have a devastating impact on careers and businesses. Just ask Alaska Airlines, USAirways, ValuJet/AirTran, and the

former Pan Am about the millions in uninsured expenses and lost bookings that tragedies have cost them.

Obviously, most of us do not want to harm another person. And most of us want to stay in business, remain employed, avoid large civil fines, and retain the certificates granted by the Department of Transportation and the FAA that authorize us to operate in this industry.

Absent deliberate sabotage, an aircraft accident should not be criminalized because criminalization of avia-

**The accident itself is its own punishment to the individuals and companies involved.**

tion serves no useful purpose. Traditionally, criminal punishment is meant to both deter and punish. In the case of an aviation accident, however, the accident itself is its own punishment to the individuals and companies involved. I have represented on many fronts SabreTech, the maintenance company employed by ValuJet when its DC-9 dove into the Florida Everglades on May 11, 1996. Does anyone doubt SabreTech learned a painful lesson? The company paid over \$14 million in uninsured expenses relating to the accident, and it is still vulnerable to additional claims. Harsh, unrelenting media coverage following the

accident helped put the company out of business first in Miami, then in Orlando, and finally at its flagship facility in Phoenix. Thousands of jobs were lost. It went from being the third largest independent repair station in the country with decent profits, to being over \$24 million in the red today. Even though its former maintenance workers were acquitted on all charges and the company was acquitted on two-thirds of the federal criminal charges brought against it, both the individuals and the company were devastated.

Based on my experience, guilty pleas and convictions are not victories for prosecutors or the traveling public. Some companies must opt for a guilty plea just to avoid the business damage and prolonged media scrutiny associated with a grand jury investigation, indictment, and trial. In this highly competitive industry, where a pristine safety record is crucial to success, no company wants to be branded in the news as potentially unsafe. And customers are understandably reluctant to continue to do business with a tainted company. In SabreTech's case, customers were upset to see their own aircraft showing up on the evening news. Even the most loyal customers are likely to leave companies accused of wrongdoing, simply for liability reasons.

In short, companies may be inclined to plead guilty. After all, prosecutors can get grand juries to indict a ham sandwich.

Perhaps not surprisingly, when individuals and company officials are aware of the possibility of criminal sanctions, they may refuse to cooperate with National Transportation Safety Board investigators by asserting their



# en t a r y

## Kenneth P. Quinn

Fifth Amendment privilege against self-incrimination. Any reluctance to cooperate undermines the NTSB's ability to learn about a problem and prevent its recurrence. Flight crews, mechanics, manufacturers, and other witnesses are understandably afraid to share what they know for fear of prosecution. This in turn undermines the safety of the aviation system.

In my view, we need to encourage a climate of cooperation and candor so people will come forward and admit bad judgment and mistakes, enabling us to find out what really happened and prevent a reoccurrence. We best honor the victims of tragedy by making sure it won't happen again, not by seeking jail time or huge criminal fines for individuals or companies that have to spend the rest of their days (which may be numbered) haunted by the fact that something they did or did not do contributed to the loss of lives.

To some extent, perhaps we're all to blame for the current erosion of confidence in the FAA. Despite the agency's enforcement role, prosecutors and victims' families seem unwilling to place their trust and confidence in the organization. Working with the FAA, we should do more to embrace change and arrive quickly at consensus improvements. All too often, we get bogged down in parochial disputes (whose ox is getting gored on a particular rule-making proposal), which impede progress. We need to ensure that rule changes and new business practices take effect in days and weeks, not months and years. Perhaps, just perhaps, through discord and myopia, we have inadvertently encouraged the criminalization of aviation accidents.

The result, however, is that the lines between our regulatory, civil, and crim-

inal justice systems are blurring. Remember that after the ValuJet crash, the NTSB held three parties accountable: SabreTech, ValuJet, and the FAA. Of course the prosecutors could not pursue criminal sanctions against their sister agency—the FAA. Yet one could argue that the FAA was reckless—perhaps criminally so—in failing to mandate smoke detection and fire suppression systems in Class D cargo compartments. But at bottom, it was just a terrible mistake, a poor judgment that cost many lives.

If we are to avoid the perils to aviation safety caused by making every accident a crime scene, we simply must act swiftly and unanimously. If the NTSB and FAA see a real danger going unaddressed, then those in the commercial aviation industry should pull together and fix it.

Finally, criminal sanctions in a post-accident environment distract the industry from learning about new threats to civil aviation. The ValuJet crash was

an immediate wake-up call. It triggered increased FAA oversight of repair stations, of new air carriers, and of hazardous materials transportation by any company, whether aviation-related or not. It triggered all types of aviation-related businesses to take a closer look at their procedures. It was the crash itself—not the criminal indictments or any convictions—that sounded the wake-up call. If anything, the criminal sanctions caused aviation companies to spend more time with their lawyers establishing criminal liability action plans, rather than focusing on the goal of making their products and services as safe as possible.

If aviation companies continue to be the targets of criminal investigations, those involved should be granted immunity from prosecution in exchange for their truthful statements. In the SabreTech case, prosecutors used truthful statements made to the NTSB and FAA against SabreTech mechanics and the company itself. The court later rejected our motions to exclude the statements. To mitigate the chilling effect, Congress could enact legislation preventing prosecutors from using truthful statements made to accident investigators. At the moment, neither the NTSB nor the FAA has the authority to grant immunity. Although prosecutors do have the authority to grant immunity, they use it sparingly. They worry that the practice will harm their ability to prosecute future cases.

To them I say: So be it. Aren't we better off ensuring candor and the admission of mistakes and bad judgment in order to prevent another loss of life than we are putting people behind bars and inviting further tragedy?

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# SOARING

DIXON WHITE TEACHES STUDENTS HOW TO USE PARACHUTES TO GO UP AS WELL AS DOWN.

# ON SILK

BY TOM HARPOLE PHOTOGRAPHS BY PHIL SCHOFIELD

***"I could huck a one-armed monkey with fleas off a 2,000-foot hill in a paraglider and it would get him to the ground in one piece,"***

Dixon White tells a group of his students. "A lot of instructors are doing that, then they bark a few suggestions into your radio and get you safely to the ground, but that's not paragliding. That's not what we're doing here."

"Here" is the Airplay Flight Park near Cashmere, Washington, a privately owned, 2,200-acre spread that looks like a series of golf course fairways superimposed on the treeless foothills of the Cascades. Paragliders, the vehicle of choice at Airplay, are aircraft that humans unfold, strap on, and, with nothing but the power generated by about four long strides of their feet, launch themselves from hilltops with. Paragliders can be stored in backpacks and are rigged as follows: A cushioned bucket seat is connected by webbing to Kevlar lines that splice into more than 100 attachment points along a 35-foot-long parachute, or wing, made of zero-porosity rip-stop nylon.

Dixon White has made more than 6,200 paragliding flights without

*Out of the sun and into the shade, a student puts himself on final approach to landing (opposite) at the Airplay Flight Park near Cashmere, Washington. Paragliding instructor Dixon White (right) demonstrates ground handling.*

hurting himself, and he has jointly supervised more than 31,000 student flights that have resulted in three minor injuries and one tragedy. When White introduces people to the sport, he mentions the incident within minutes of beginning the orientation. The single fatality that he has seen at his school was a young skydiver headed for the U.S. Navy SEALs, who, on his fourth day of flying, disregarded White's instructions and attempted a series of maneuvers that resulted in his becoming wrapped up in his glider and falling 100 feet. After bungling a turn, he immediately worsened his situation by pulling too aggressively on the glider's controls, drawing the canopy underneath himself and falling into it.

"You must gently and thoughtfully manage the energy of a paraglider," says White. "It happened so fast there was no way to respond in time. It was the biggest emotional setback for me and my wife ever." White rakes his hand through his wavy brown hair; at age 43, he still has leading man good looks. He looks up and says: "Watch this sky, everybody. Cumulus being born. Hero air."

About a mile above us, two of White's instructors, Ryan Swan, a world-class extreme skier, and Brett Zaenglein, the

1999 U.S. National Sport Class champion paraglider pilot, are twisting up a thermal at 1,600 feet per minute. Against the popcorn cumulus sky, the pair of gliders look as slender and agile as nighthawk wings. Swan and Zaenglein are rising dramatically as they work the thermal, and White explains what they're doing.

"When Brett and Ryan bounce a bit, they're moving through the edge, trying to figure out the size and shape of the thermal and [how to] stay in it up to [the] cloud base, where they lose their lift," says White. Thermals act like campfire smoke; they aren't really columns or pipes. They drift and change shape. They can be as wide as a football field, "big and boaty," or "wing-rocking bullets," he says. "Raptors have those finger-like feathers

at their wingtips so that they can be more sensitive about finding the rough edges of thermals and shearing into them. We feel the edges of thermals with the tips of our gliders and turn into them and try to stay in them. You folks will do this in a year or two if you stick with this."

Suddenly White's radio spits out Swan's voice. "It's getting pretty sporty," he says, an attempt at undaunted understatement. But the combination of the cold temperatures at altitude, the turbulence, and the tiny speaker renders his voice puny. Zaenglein, speaking to Swan, adds, "Pretty spicy. Whoa!





Falling out the backside. Don't come over here." White's eyes are skyward, appraising his prodigies. "Pretty textured air, real active stuff," he says. "Those guys are so cool. Those are my two best boys. On a good day, with a little luck, they might outfly me." It ain't bragging, they say, when it's true.

We watch the wings of Swan and Zaenglein spiral higher. "How's it now?" White queries into the radio. "Can't talk, gonna die," says Zaenglein. White laughs and we know he wants to be up there with them. He shrugs and grins and turns his attention back to the gaggle of fledglings he is training. The influence White has had upon the sport of paragliding was recently acknowledged by his peers, who voted him the United States Hang Gliding Association Instructor of the Year in 1999. It was the first time in the 28-year history of the association the title was awarded. More than 140 letters arrived at USHGA's headquarters in Colorado Springs, Colorado, citing such White contributions as making safety a fundamental and systematic series of habits, and weather a part of the sport understandable to lay people. "He's one of the best," says Phil Bachman, ex-

*White (standing) employs a tethered harness to teach flight control techniques from the safety of a classroom.*



***"They begin with the simplest little downhill flights, barely off the ground. Then we get them started on 'sled rides,'***

***gliding down our 800-foot-tall hill***

***into Spirit Canyon."***

ecutive director of the USHGA. Marty DeVietti, White's head paragliding instructor, was voted Instructor of the Year for 2000, distinguishing the school from more than two dozen others in the United States.

White is also training two apprentice instructors, Denise Reed, the 1999 women's boxing champion of Alaska, and her pal Doug Stroop, both chemists who abandoned careers in the oil industry to fly paragliders. Reed and Stroop traveled from Alaska on a week's vacation to take paragliding lessons with White. They then went home and started making plans to quit their jobs, lay aside the boxing gloves, and go paragliding full time. The sport is replete with adherents who have quit jobs, left lovers, divorced, sold off belongings, and altered all routines to pursue this form of flight. There are approximately 4,000 USHGA-registered paragliders in the United States and 300,000 worldwide, and every one of them has seemingly neglected someone or something to partake of the sky.

Paragliding has been far more popular in Japan and European nations than in the United States, possibly because these smaller, more congested countries don't have as many airports to support general aviation flying as can be found in the U.S., making paragliding a practical choice for those who want to fly. Still, according to the USHGA's Phil Bachman, the number of paragliding pilots is increasing in the United States, particularly in Colorado, California, and the Northwest. The USHGA sanctions four official paragliding competitions a year, and there are about the same number of non-USHGA events, most of them held during the summer.

**U**p in Whisper Valley, the site of the beginner's slope, Reed and Stroop help students spread their wings in spots all across the 400-foot-wide upper valley. White literally runs back and forth instructing apprentices and students. One student at a time, with White at his or her side, raises the

canopy into a gentle breeze, brings it overhead, and sets it back down. Within an hour or so, one by one, with White running downslope and helping them launch, they begin making 200-yard flights that look like moonwalking, taking 50-foot hops or skipping on tiptoes for a 100 yards. This takes a splendid few hours, which extend into the evening when long shadows cool the valley and stop the thermals. "We're done flying," White tells his students.

When European mountain climbers began paragliding in the late 1980s, flying the new rectangular sport parachutes from summits as a way of getting down quickly, the launches looked different. The climbers would lay a sport chute behind themselves and start running downhill to inflate it. More than 10 years later, after White had joined the sport and become a master pilot and instructor, he began changing it fundamentally, starting with the act of getting off the ground.

Launching a paraglider, if you follow White's reverse method, reminds me of handling draft horse teams, as I did in the forests of Oregon 25 years ago. Giving a team the giddy-up with your back to them wouldn't make much sense, and neither does launching a paraglider that is behind your back. "Any instructor who doesn't teach reverse launches is behind the curve," says White.

To launch, you stand facing upslope, holding lines in both hands, with the wing, or sail, laid out in a 30-foot horseshoe shape on the ground before you. The lines give you information as you step back, pull lightly, and raise a little wall of sail into the wind. The open cells on the leading edge begin to inflate and climb up in front of you, tugging at your arms and the harness points at your hips. You head downslope. Your arms control the paraglider's sail as if it were a pair of wings, allowing each side to ascend or descend. The feeling in the lines can be like that of a team





*Lifted by warm air rising from the hills of Cashmere, White demonstrates a textbook takeoff.*

of freshly broken coach horses, each wanting to dash off in a different direction, or it can feel like a hitch of docile Percherons gathering their shoulders into the harness and pulling you unfalteringly up a mountain road. Steering the wing requires sensitivity and skill at feeling subtle sideslips, forward and backward surges of air, and managing the horsepower up there at the end of the lines.

The horse analogy is apt even when the wing is inflated and producing lift. Horsepower is a measure of moving weight over time. Lower a 220-pound weight down a 150-foot-deep well, then raise it to the surface in one minute and you have exerted 33,000 foot-pounds per minute, or one horsepower. White, who weighs around 200 pounds geared up, has ascended at 2,200 feet per minute, which works out to 440,000 foot-pounds or roughly 13 horses and a pony pulling a human closer to the heavens every minute. Ghost riders in the sky.

**W**hite incessantly teaches people to read the air. Standing in a restaurant parking lot or gazing out the post office window, he draws

all eyes to the sky. The life that White strives for, up in that exquisite world of weather, has come along a fairly circuitous route. He worked as a back-country ski guide through his teen years, then left a seven-year career in the circus as a tight-wire walker, juggler, and unicyclist. "I was stagnating in the circus," he says. "I wasn't exactly Johnny Carson material."

He then started an appliance store in Arizona and was earning \$120,000 a year when, in 1990, he discovered paragliding and became obsessed. His wife Debra agreed that they should sell their \$350,000 home, horses, and business so that White could figure out how to make a career of paragliding. They moved into a double-wide trailer in Flagstaff with their two toddlers. The next year White earned \$27,000 teaching humans to fly.

He began offering lessons after being certified as an instructor by the U.S. Hang Gliding Association. He set up shop in a garage, where he sold the arcane accoutrements of paragliding. Today, eight years later, he runs two schools. He also sells equipment to current and former students, but relies on the kindness of wealthy patrons to keep the whole deal afloat. "If you

want to make a million teaching paragliding, you better start with two million," says White. A cheerful coterie of Microsoft millionaires, all Airplay alumni, fly with him and help keep the operation coasting, including Jabe Blumenthal, the man who owns the land near Cash-

mere where White conducts classes. Blumenthal had been paragliding for several years in Europe and the United States when he accompanied White



*After learning paragliding from White, Ryan Swan, Brett Zaenglein, Denise Reed, and Doug Stroop (left to right) now work as instructors at his schools.*



on a paragliding tour of the West Coast. He bought the Cashmere site because it had some of the best terrain and summer flying weather anywhere near Seattle. "I wanted to put together the best flying school possible," he says. "Dixon struck me as the best instructor I'd ever run into. He's intense, too much so for some people. But he is the best."

At the Cashmere school, a three-hour drive from the Seattle area, White charges \$800 to instruct pilots to the novice level, which requires 30 or so flights using the school's equipment, and teaches around 60 students per year.

Steven Wilson, a 41-year-old Microsoft retiree, took up paragliding more or less full time in 1998. "I started taking lessons with Dixon and became, well, obsessed," he says. Wilson, who worked in the company's international marketing division, recalls sitting in fruitless meetings in windowless rooms, knowing that the weather was good for flying. Finally, he just couldn't stand it anymore. Since he quit his job, he has logged more than 400 hours, often staying aloft for more than two hours at a time. "The season begins in earnest in April in the Northwest, and I'm out at one of about 10 sites at least three times a week," says Wilson. "Then from June through August, I average about 25 flights a month."

Cross-country flights are dependent upon the sun heating the ground and creating thermals, rising masses of warm air. From October to May the upper corner of the West Coast clouds up a lot, so White runs his schools and sells equipment in Washington during the summer and in Arizona in the winter. Five thousand dollars should provide an aspiring pilot with a beginner's glider, harness, boots, helmet, radio, altimeter, and lessons that result in a novice pilot's rating.

On the first day of a lesson with White at the school in Cashmere, usually held around the ranchhouse picnic tables, he advises students that he doesn't want them referring anyone to him for lessons who doesn't have the money to buy equipment and the patience to learn the sport. "Send me people who have always wanted to fly, who dream about it and talk about it and who you think can become completely preoccupied with it," says White.

"Don't send me any Mountain Dewers. I'm not here to give joy rides. They'll find instructors who do."

Many of White's students are current or former aviators, such as Bill Holsgrove, a DC-10 captain for Hawaiian Airlines. Joe Rumble, a 73-year-old former smokejumper, has flown with White 102 times since 1998. "I've been around aviation all my life," says Rumble. "I tried to get a pilot's license in the '40s but got short-stopped. Then, at age 70, I got started with Dixon. Man, it means a lot to fly."

Marty DeVietti, White's chief instructor, is an instrument-rated fixed-wing pilot with a bachelor's degree in aviation technology. He started taking paragliding lessons in 1991 at the North American Paragliding school in Ellensburg, Washington, and he worked at NAP

**Gerdes decides to abort the launch. "Good for you," says White.**

**"Launches are optional, landings are mandatory.**

**Don't ever let anyone**

**tell you when you are**

**ready to fly. You**

**are a pilot in com-**

**mand of your**

**aircraft."**

for five years as an instructor. "The quality of my instruction was first rate, and I felt that the program we had [at NAP] was very comprehensive," says DeVietti. "However, after five years, it seemed that the program was more or less the same as when I started. Meanwhile I had noticed pilots from Dixon's school who were being taught in ways that seemed very progressive." In 1998, DeVietti started working at White's schools as an instructor.



*Paragliders fly at two basic speeds: slow and very slow. The top speed of the unpowered craft is only 26 mph.*



He and White have schooled a plethora of former general aviation pilots who quit flying because of the expense. But the sport also appeals to those who dislike airplanes, like White. "My dad and mom were both fixed-wing pilots," he says. "Mom gave it up when she had me. My dad would take me up and tell me to keep on a bearing and altitude, then he'd lean back and read a magazine. I'd be scared, then bored. I hated the smell, the radios, the equipment-intensive environment. I don't like being a passenger."

Even hang gliding left White feeling indifferent. "I had a tandem hang glider flight once and didn't think much of it," he says. "They require assembly, they rattle, and they make me feel like a passenger. In a paraglider, I'm a piece of the aircraft. Knees in the breeze, managing the energy of all that sailcloth. It is the most fun you can have with your clothes on."

Far more serious than fun, however, is the business of teaching others to fly, and managing students' emotions, says White, is the toughest part. Matt Gerdes, a broadly grinning, hip, 22-year-old river guide, is having a great second-day lesson. He stands harnessed to his grounded glider, fussing with the sets of risers, or webbed straps, gathered in his hands. White walks over to help him launch and surreptitiously throws a tangle into Gerdes' lines that would not impede a safe flight. "You look ready," says White. "Go ahead."

Gerdes pulls the glider into the air but immediately aborts the launch. His paraglider's wing has risen up on one tip like a rampant caterpillar, folded itself over like a fortune cookie, and rolled up into a bird's nest of webs and lines. "Good for you," White applauds. "Launches are optional, landings are mandatory. Don't ever let anyone tell you when you are ready to fly. You are a pilot in command of your aircraft." As Gerdes looks crestfallen at the mess of lines, White gives him a hint on how

to begin the untangling before walking away. "Too happy too soon," he tells me. "He was getting complacent."

White surveys the hillside and approaches an ex-Marine who wears black

pants tucked into black boots and a T-shirt about tequila. In two days he has had eight short flights and a couple of sublime four-minute glides. "How's it going?" says White. "Lousy launch," says the ex-Marine, seeking commiseration. White faces him and starts in loudly: "You've just had two days of great

weather and some beautiful flights. Lose the attitude. In fact, I can't stand listening to negative crap up here. Bad attitudes anticipate failure and cause accidents. One more complaint and you don't get invited back." This "straighten up and fly right" tirade makes the other aeronauts on the slope fall silent, like a lull in the wind. The former Marine stands at parade rest. "Please get after some ground handling and kiting," says White quietly. "Look at what fun everyone else is having."

White watches a more advanced pilot screw up a launch by mishandling his glider. He bites his tongue, turns to me, and says, "At some point I have to stand back and let them learn from blowing it." Then he jogs over to help Matt Gerdes sort out his wing.

That night over ice cream with his apprentice instructors, White agonizes about a 300-pound student whom he reluctantly allowed to take lessons. That afternoon the big man belly-flopped a couple of times and began blaming his awkwardness on his glider's performance. Swan and Zaenglein had watched incredulously as White ran downslope with the man on a launch and hung to the bottom of his harness as the guy got airborne for the first time. A gust carried them 12 feet into the air, whereupon White let go, tumbled, and popped up, still loping downhill and shouting directions to the big man trying in vain to fly.



*White devised the reverse launch, in which the pilot faces the canopy, steps back, and rises into the air. In the past, pilots had taken off by running downhill with the canopy behind them.*

"I don't think I can let him come back," he says, looking solemnly at the apprentices. "His weight isn't the problem. If he told me he loves this and said some things about how fun it is, I'd stick with him. But he's doing it for reasons that I can't understand."

The challenge of paragliding is that it takes place in an element that is invisible. Paraglider pilots have to deduce from easily missed cues how to find the rising currents that keep them airborne. They begin by looking and not seeing things in the air, and they progress, under White's tutelage, to knowing where thermals are rising and flying boldly into their rough edges. He teaches advanced pilots how to ascend thermals to the highest altitude possible, how to glide and look for where the next one will be rising, and how to link up a series of these ascents and glides, a process that makes cross-country flights of more than 200 miles possible.

Of his students, DeVietti says: "They begin with the simplest little downhill flights, barely off the ground. Then we get them started on 'sled rides,' gliding down our 800-foot-tall hill into Spirit Canyon." With the 7:1 glide ratio of the

*Joe Rumble, 73, had always wanted to fly airplanes but never found the opportunity to do so. Three years ago he began paragliding lessons and has since logged over 100 flights.*





wings, those rides carry students nearly a mile in four or five minutes, with White or DeVietti up at the launch site talking to them by radio about how to handle the wing. "Soon the novice pilots want to start staying up longer and we take them to some higher places and get them soaring, staying up over the same place for a while, managing lifting air," says DeVietti. "Then it gets to be time to try some cross-country flights. You start to consider what it would take to go over there. You start getting into more unstable conditions, more dramatically lifting air, which is what you need. Then you really begin navigating through some turbulence in the great river of air. At that point in a pilot's progress, the decision to stay up depends largely on how the afternoon heating goes, and how much more turbulence the pilot wants to deal with. You also have to consider that as the afternoon heats up, landings get trickier."

Students are told on day one to show up the next morning with weather information: the winds aloft, temperatures, and the location of the jet stream, all of which can be obtained by calling 800 WX BRIEF or tapping into White's Web site at paraglide.com. He gives students succinct criteria for deciding whether to fly, based on information they gather in the morning. Beginners look at isobars—lines on weather maps that connect points of equal barometric pressure—and are told to forget about flying when there are more than two isobars within 300 miles. The closer together the isobars are, the higher the winds will be that day. And if the jet stream is within 100 miles of where you are flying, the base winds will be too high for safe flight. If the barometric pressure has dropped, unsettled weather is on the way.

If the initial weather predictions for the day are propitious, then paraglider pilots must observe the conditions

at the launch site. They are instructed not to fly if cumulus clouds are taller than they are wide, if there is a multi-layered sky with clouds moving in different directions, and if wind gusts increase more than five miles per hour in five seconds—all signs that the air is too turbulent for safe flights. But if the signs are encouraging, students must start learning how to detect and use the thermals that create lifting air.

White uses an image to explain how thermals bloop up into the atmosphere. Slightly overfill a glass of water and surface tension allows it to bubble up over the top of the vessel. That tension is a fragile agreement between molecular attraction, barometric pressure, and gravity, and it breaks easily. Likewise, once the sun starts warming the ground, bubbles of warm air form along the surface, and eventually they exceed their ability to grow, whereupon they burst and rise. Their release may also be triggered mechanically, by something as small as a rabbit running through them.

**A**s the mid-day sun bakes a south-facing slope in the flight park, White sits, sweating from a dozen sprints up and down the hill, his hands on novices' harnesses and brake lines. "A

lot of my friends who used to instruct beginners have quit," he says. "They can't take this running down the hill." White watches the tilted slopes for ripples in the wheatgrass and sage, signs of thermals releasing. "This is closer to what surfers do than aviators," says White. "Waiting, watching, gauging. Wanting a ride." He considers that momentarily, then says, "It's also like scuba diving, where you put people in an element where they have no reference points. There's nothing they've done before that transfers. People who try this have never done anything remotely like it in their life."

DeVietti, on the other hand, has drawn upon his experience flying airplanes.



*White, who favors a hands-on approach with his students (above), expects them to have positive attitudes.*

## "Small plane pilots want to get through thermals;

Work-  
ing your  
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on thermals is  
an experience at  
least fleetingly fa-  
miliar to light airplane  
fliers, and many a fixed-  
wing pilot knows that the  
difference between the lift-  
ing mass and the ambient air  
can be very dramatic. Indeed,  
paraglider wings can temporarily  
deflate on the side entering the shear  
between turbulent and calm air. It is  
at this point that an inexperienced  
paraglider pilot may put the glider into  
a steep bank, pull the wing under him-  
self, and become "gift-wrapped," says  
DeVietti. If that happens, "you hope  
you're high and have time to sort the  
situation out and regain normal flight."  
If not, the pilot can deploy his reserve  
canopy.

"Small plane pilots want to get through thermals; paragliders make their living in them," continues DeVietti. "Once you get through the rough edge, they can be big, and you're in there with three or four friends. Or they can be small and hot and fast and you make tight turns that still get your wingtips into the sporty edges and you are working real hard to stay inside them. It's like flying inside a Pringles can. Your wing is going asymmetric on the edges and you bounce around a bunch." Fifty-percent-asymmetric wing deflations can occur and become less disconcerting as a pilot grows confident in the wing's recovery characteristics.

White lays his hand on a patch of soil between stalks of mowed bunch grass. Using his wristwatch thermometer, he determines that the ground temperature is 114 degrees. "The whole valley is cooking up bubbles of warm air," he says, smiling. The thermals, which had been releasing roughly every 15 minutes for the last couple hours, are whooshing uphill more often and much more forcefully. The air is too sporty now for beginners, so White loads everyone back in his big white Ford crew cab and heads down the hill.



He drops the students off at the picnic tables under the big maples at the school's ranchhouse and points at the wooded, rocky throat that defines Hay Canyon opposite us and tells us to look up in a few minutes. He explains that he, Brett, Ryan, Doug, and Denise will drive back up, hike another 600 feet to the top of the mountain, and launch.

Half an hour later, from the picnic tables, we see them cutting S-curves up there, searching around for thermals. They rise and then glide down close to the ridges that lead into Hay Canyon. They continue rising and gliding, five humans within shouting distance of one another at 11,000 feet.

After they land, we learn that Zaenglein and Swan linked together a progression of thermals and glides that took them 35 miles over the easternmost jags of the northern Cascade mountain range at altitudes above 13,700 feet. (The two men were not carrying oxygen since they had not expected to fly so high. But it is not uncommon for paragliding pilots to carry oxygen if they anticipate flying above 12,000 feet for sustained periods.) They landed at

a ski area and hitchhiked home. Says Swan: "You can't just extract what you want from the weather, but sometimes you get more than you hoped for."

At one point Swan was 4,000 feet lower than Zaenglein, gliding ever closer to the slopes below in search of a thermal to carry him back up to Zaenglein's altitude. "I was kicking treetops, stuck in a shaded mountainside and sinking," says Swan. "Thought I'd get dirtied"—meaning he'd land where he didn't want to. Swan had visions of getting hung up in a tree, tearing his \$3,600 paraglider, perhaps falling a hundred feet to the ground, and being 15 miles from the nearest road. "I flew in the shade, lower and lower, and finally got around a corner of this ridge, and there was some sunshine and a rocky slope heating up and I worked that back up," says Swan. White jacks Swan up a bit: "Today you were in no-man's land. You did something no one else has ever done. Just be very, very satisfied."

During the week that I studied with White, the human genome mapping was completed. He rhapsodized one evening, while balanced on the tightwire

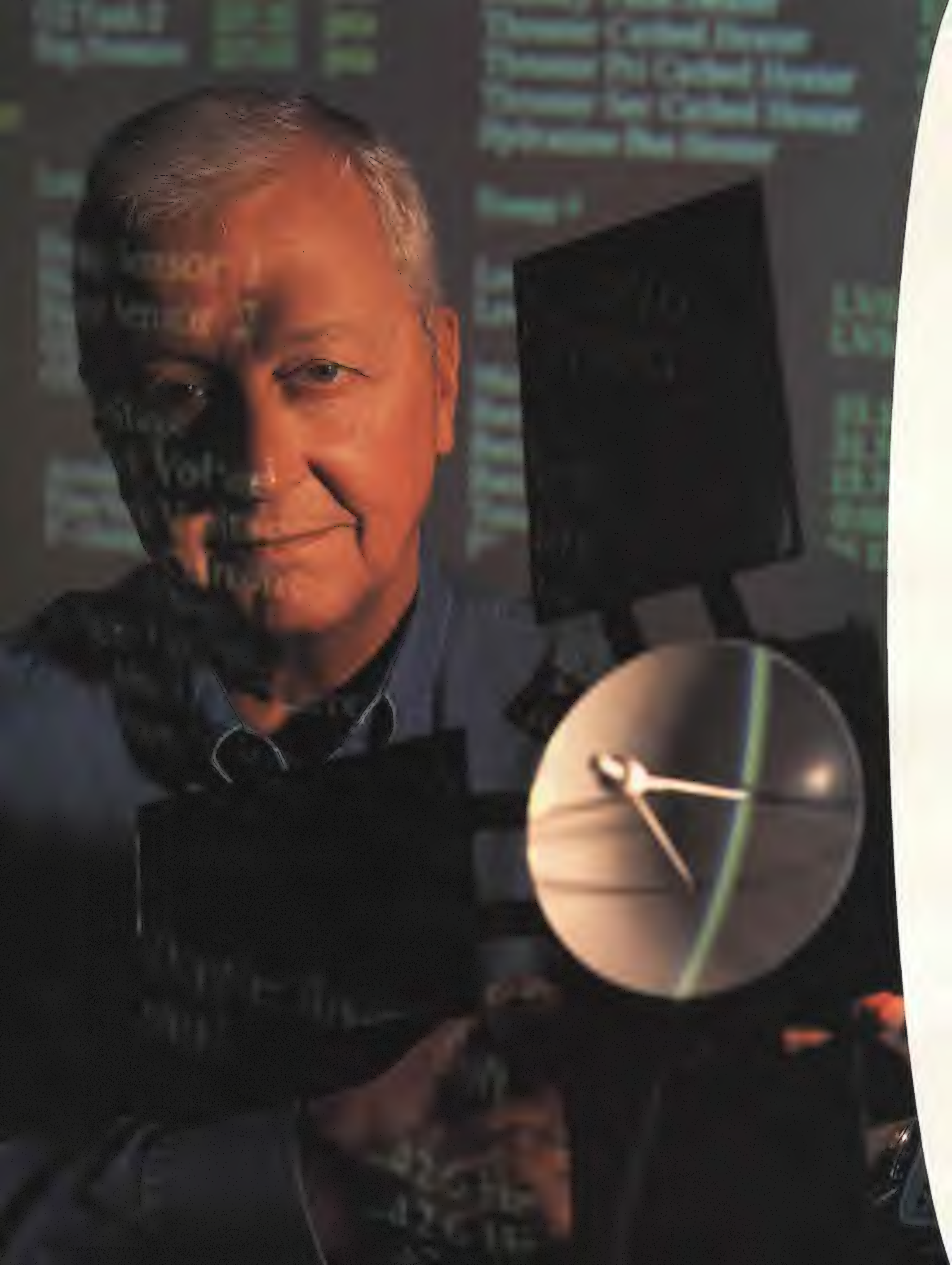
he has set up outside the school's ranchhouse, about how someday humans would fly without fabric wings, presumably through some genetic manipulation he hopes to see in his lifetime. It was hard to listen to such an uncharacteristically wacky discourse. I asked him if he believed that there is a risk-taking gene, expecting him to launch a lecture on how safe this sport could be with a thorough knowledge of weather and equipment and the appropriate attitude, etc. "Of course there is," he said. "That's a definite gene, a necessary gene. Human society didn't evolve without risk-takers."

White once walked 1,000 feet up a cable that suspends a ski chairlift at Aspen, Colorado. I got a little snotty and asked him if that was an example of a risk that moved society forward. He looked down at me patiently from the tightwire, upon which he had been balancing for more than half an hour. "We're explorers," he said. "We are testing the outer reaches. Good explorers aren't adrenaline junkies. They prepare themselves as fully as they can, and then head out there." —

*An experienced tightwire walker, White believes the desire to fly should be balanced by a respect for safety.*









# Hang a Right at Jupiter

by Michael Milstein

For space navigators, the best course to a distant object is never a straight line.

**B**ob Farquhar feels lucky. And that's good, since there's nothing he or anyone else can do now but hope for the best. His spacecraft is out there on its own, 119 million miles away, and whatever's going to happen next has already been programmed into the onboard computers.

Farquhar, whose mild manner seems more like that of a high school teacher than a space explorer, watches and waits from an unlikely place—not the Jet Propulsion Laboratory in Pasadena, California, headquarters for almost all past U.S. interplanetary missions, but a nondescript building at Johns Hopkins University's Applied Physics Laboratory, outside Baltimore. It could be any office park in the country, except that the room in which Farquhar sits—at the head of a long conference table—is linked to NASA's Deep Space Network. At the moment, one of the network's giant dish antennas is relaying signals from a boxy little spacecraft called NEAR Shoemaker in orbit around a potato-shaped asteroid known as Eros.

NEAR stands for Near Earth Asteroid Rendezvous, the first spacecraft ever to match orbits with an asteroid and hang around for an extended study of its chemical and physical makeup ("Shoemaker" was added to the name in memory of the late astrogeologist Eugene Shoemaker). While Farquhar and his team monitor the signals, NEAR orbits 62 miles above the slowly tumbling asteroid's surface. The satellite is about to go in for a closer look, firing thrusters to cut the orbital altitude in half.

Farquhar has just learned that the engine burn, the instructions for which were long ago loaded into the spacecraft's computers, should last 144 seconds, nudging the craft from its piddling 5 mph to a whopping 6.5 mph. "Oh, that's great!" he exclaims, drawing quizzical looks from others watching a screen full of numbers charting NEAR's position. "144 is 12 squared. 12 is a lucky number. I was born September 12. [My first space mission] launched 12 minutes and 12 seconds after the hour and can you guess what the date was?"

"August 12."

Farquhar's faith in lucky numbers should not be easily dismissed, considering that he and his colleagues have

sent spacecraft where no one thought possible, on less fuel and in less time than most people would have guessed. He calls himself an astrodynamicist, but he's the unofficial king of the space navigators, a cadre of behind-the-scenes engineers who direct shiny, expensive spacecraft from here to there, with here being Earth and there being an asteroid, comet, planet, or moon.

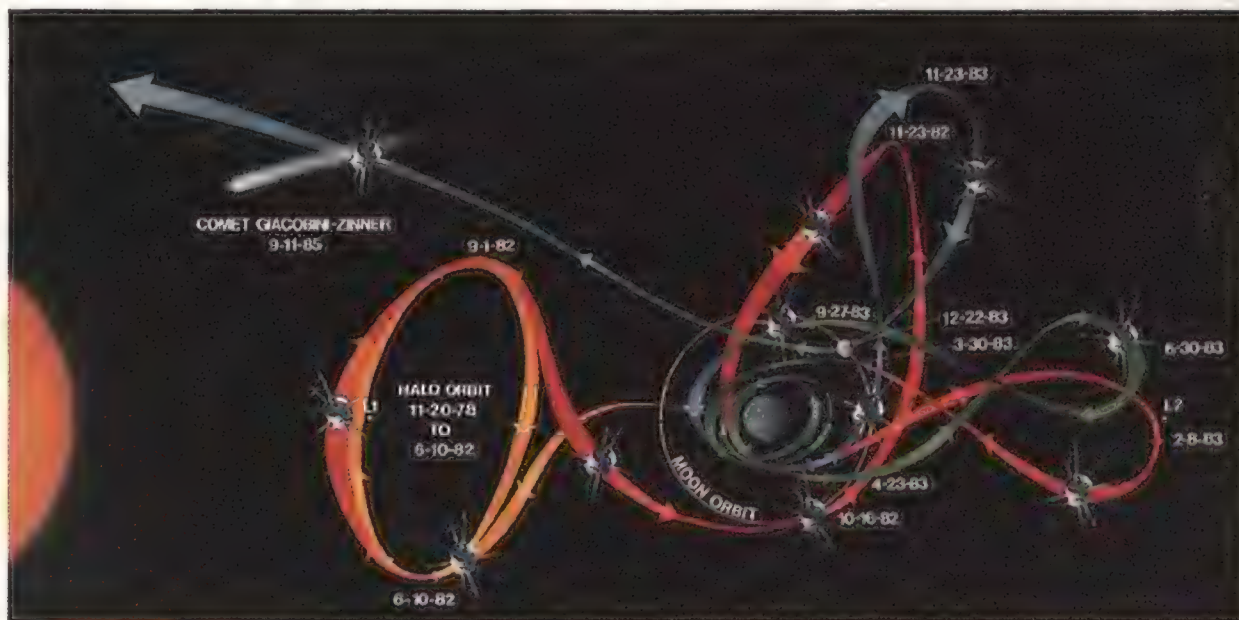
Space navigation is like threading a needle, only a thousand times harder. With today's space missions aiming at ever smaller targets (like asteroids), the eye of the needle gets so narrow, with so little room for error, that those threading it either succeed spectacularly, like Farquhar and his team have done so far at Eros, or they miss.

And in space, there's no way to miss but spectacularly.

That's what happened to the Mars Climate Orbiter, which vanished in September 1999 as it prepared to enter Mars orbit because of a now-infamous confusion between metric and English units—and more to the point, because it wasn't where the navigators thought it was. The incident forced JPL space navigators into an unfamiliar and uncomfortable spotlight. It also proved—the hard way—that accurate navigation is every bit as vital to space exploration as raw rocket power.

In the early days of space travel, accuracy was relative. Mission planners were more than happy in the mid-1970s to put a Viking spacecraft within 25 to 30 miles of its planned orbit around Mars, recalls Myles Standish Jr., who left Yale's

*Navigation wizard Bob Farquhar (opposite) delights in clever spacecraft maneuvers, such as re-routing the ISEE-3 to fly past a comet.*





astronomy department for JPL in 1972 to work on the Viking project. Tall and debonair, Standish, a distant relation to the Mayflower captain of the same name, is one of the few top JPL navigators who doesn't belong to the "Texas Mafia," a contingent of University of Texas astronomy and engineering graduates who seem to dominate the laboratory's navigation and mission design section.

In those days, when Mars was being reconnoitered for the first time, the scientific goals and the aiming requirements weren't as exacting as they are now. Today's follow-up missions demand high-resolution photography and pinpoint targeting. And, says Michael Watkins, chief of the navigation section, "We're doing it faster, and we're trying to do it with smaller spacecraft and less fuel."

Navigating in space is not fundamentally different from taking a road trip on Earth. First you need a map. Then you plot your course, decide what kind of vehicle to take, and calculate how much time and fuel you'll need. Once en route, you compare your actual progress to this plan and adjust as necessary. All the while, you have to prepare for contingencies: What if we miss this turn? What if we use more fuel than we'd planned to?

Given that everything in space is moving constantly, the spacecraft navigator faces a last, even more devilish problem: What if, upon arrival, the destination turns out not to be where we thought it was?

Squirreled away in his office at JPL, Standish works at keeping such surprises to a minimum. His computer-generated ephemerides—which list the past, present, and future positions of all nine planets, the moon, and the sun—amount to a combination map and train schedule for meeting up with any large body in the solar system. Since planets move in predictable patterns, pinning down their past locations helps Standish plot their future positions. His ephemerides extend back as far as 3000 B.C. and forward to A.D. 3000. They're

calculated from an eclectic mix of sources—everything from telescope observations by Galileo to records of eclipses in ancient Babylon.

More is at stake than just a spacecraft missing its target. Mission planners also want to make sure that some long-forgotten probe sailing through the void a thousand years from now won't crash into a distant planet and accidentally contaminate it with terrestrial microorganisms. "When it comes to navigation," Standish says, "you are always trying to think of things that can happen that you wouldn't normally think of."

With Standish watching the planets, others at JPL track the solar system's 67 known moons as well as its thousands of asteroids and comets. All of these objects push and pull on each other in subtle and hard-to-predict ways, and these changes throw the objects off their paths and necessitate constant recalculation of their orbits. Comets prove even more difficult to track, because the action of sunlight burns off dust and gas, which produces a rocket-like thrust powerful enough to drive the comet off course. "They just don't behave themselves," laments Donald Yeomans, Standish's colleague at JPL and the man charged with mapping the travels of comets through the heavens.

Over the years, ephemerides—and therefore space navigation—have become more precise as more observations are entered into the database and new instruments are built that can measure celestial positions ever more accurately. But space navigators still accept unpredictability as a part of doing business. Because of the new precision, subtle forces of gravity and solar wind come more into play when calculating routes through the solar system. Navigators try to anticipate every tug on a spacecraft but it's a constant struggle.

Part of what makes Farquhar so good at his business is that he was among the first to appreciate that in the new era of cost-constrained space missions, you had to substi-

JPL's Myles Standish helps ensure on-time arrival for NASA's spacecraft.



CHAD SLATTERY



tute imagination and cleverness (free) for rocket fuel (expensive). Instead of countering gravity's pushes and pulls, he found new ways to use them. In the 1980s he earned kudos in the space community by re-routing a little-known spacecraft called the International Sun-Earth Explorer 3—using gravity swings past the Earth-moon system—to fly through the tail of a comet called Giacobini-Zinner months before the world's space agencies managed their own much more expensive missions to Comet Halley.

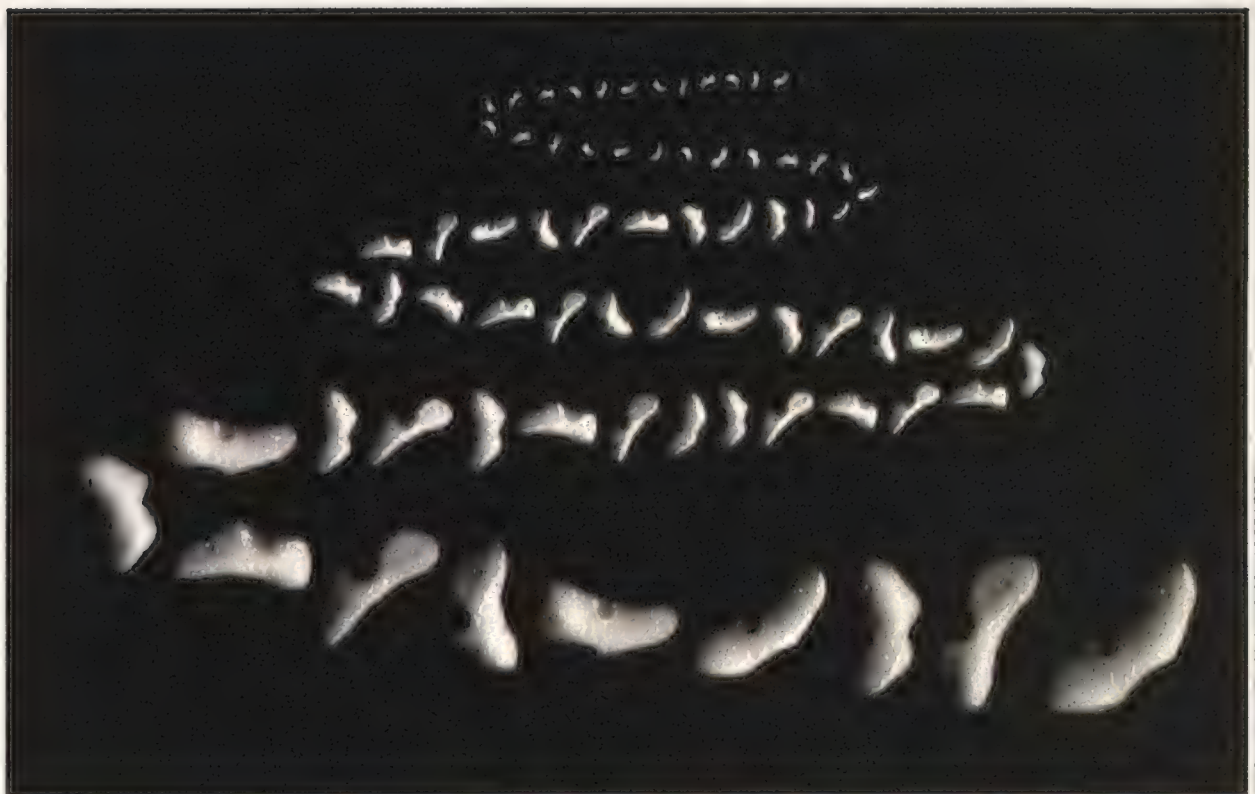
Now Farquhar is back to his old tricks, using some very delicate maneuvers to close in on Eros. Although the asteroid's gravitational pull is so weak that a person standing on the surface could easily lift a car, it's just enough to hold the 1,800-pound spacecraft in orbit. It's slow going, though: If NEAR were to orbit much faster than its current few miles per hour, it would break free and fly off into space.

Sitting in the conference room, which doubles as mission control, Farquhar and his team track NEAR's position by watching the radio signals coming back to Earth. If the signals are Doppler-shifted—like the change in pitch of an ambulance siren as it gets nearer—controllers know that gravity is accelerating the spacecraft in ways they hadn't expected. Careful tracking is essential when dealing with an enigma like Eros: before NEAR's arrival, nobody knew the asteroid's exact shape or dimensions. Lacking a good map going into the encounter, engineers had to rely on tracking data—and first-time pictures coming back from NEAR's cameras—to nail down the spacecraft's location before committing it to its next move.

Farquhar delights in spacecraft navigation, and actually seems to relish all the complicated dips and detours. His longtime colleague Dave Dunham, who works out of a small basement office elsewhere on the rural APL campus, sifts numbers through his computers to find trajectories that offer the greatest advantage in terms of "delta-V"—a measure of the total change in spacecraft velocity, which translates roughly to the number and duration of engine burns and therefore to the amount of fuel a spacecraft has to carry. A mission that requires too much delta-V is dead before it even gets to the launch pad.

Farquhar's team, for instance, could have launched NEAR in 1998 on a direct path to Eros, but it would have required so much delta-V that the mission would have needed an expensive Atlas rocket—prohibitive for a program with a budget cap of \$150 million. The extra fuel would have left less room for scientific instruments. And there was one other fatal flaw. "Mars Pathfinder would have launched first," Dunham says, in a tone suggesting that he would have found it unthinkable to let a JPL spacecraft take credit as NASA's first Discovery-class mission off the launch pad.

So Dunham set his computers humming and found a more



*The tumbling asteroid Eros (shown here in a time sequence taken during NEAR's approach) was a challenging target for space navigators.*

NASA/JHU APPLIED PHYSICS LABORATORY

roundabout trajectory that used a gravity assist from Earth to pick up some free delta-V. It called for a launch in 1996, thereby beating Mars Pathfinder into space and using a cheaper and less powerful Delta II rocket. Looking over computer printouts of the spacecraft's course, Farquhar noticed another dividend: With a little more delta-V, NEAR could fly past a smaller asteroid called 253 Mathilde on the way to Eros. So they added one extra engine burn—in technical parlance a "trajectory correction maneuver," or TCM—to take the closest-ever portraits of an asteroid only one day after Farquhar's wife's birthday in 1997. (The Eros rendezvous, by the way, took place on Valentine's Day 2000—just right, Farquhar figured, for an asteroid named for the Greek god of love.)

TCMs are at once a space navigator's best friend and worst enemy. They give the mission designer control over the spacecraft's route and the power to adjust errors in its course. But if they don't go just right—engine burns are timed down to the second—they can introduce new errors in the trajectory. And each burn presents one more opportunity for something to go wrong, whether it's a fuel line breaking, a valve sticking, or a tank exploding. "Every time you enable the thrusters, you're taking a chance," says Bobby Williams, leader of the JPL team providing navigational support for the NEAR mission, whose accent identifies him as a member of the Texas Mafia.

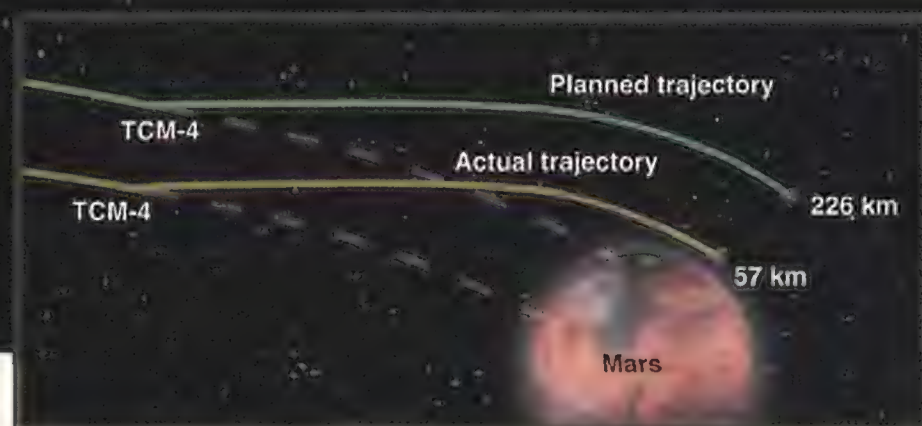
The NEAR team was rudely reminded of this risk in December 1998, when NEAR fired its thrusters to enter orbit around Eros. For reasons that still aren't clear, the spacecraft went into a tumble. In what Farquhar now benignly calls an "unscheduled fuel dump," it started spewing propellant, then shut itself off. For a tense day, the team feared the craft had been lost. In fact, it had reverted to a backup "safe mode," aiming its solar panels at the sun to recharge its batteries, which had taken it out of contact with Earth. Controllers finally reestablished contact, but the mishap threw NEAR far off course.

Fortunately, Dunham, well-prepared navigator that he is,





*Trajectory Correction Maneuvers (TCMs) are standard practice for missions like the Mars Climate Observer. But controllers didn't realize the craft was steadily drifting off course in a direction difficult to track from Earth.*



had devised a plan to use in the unlikely event the maneuver failed. It took another year to loop back to Eros, and a little more delta-V, but the spacecraft finally made it, getting as close as three miles from Eros this October.

"You should always have a contingency plan and a generous fuel supply," Dunham says with a satisfied grin.

**E**xtra fuel wouldn't have been much help to the hapless engineers in charge of JPL's Mars Climate Orbiter, whose story serves as the great cautionary tale of modern space navigation.

Launched in December 1998 to study the Martian atmosphere and relay signals from the Mars Polar Lander, which followed it, the Mars orbiter had an idiosyncrasy that flustered navigators: Unlike the Mars Global Surveyor that preceded it, the craft had solar panels that stuck out to one side. The lopsided design created a kind of sail that caught the solar wind, torquing the spacecraft around. Controllers had to counteract this force every day using onboard reaction wheels—spinning flywheels that could absorb the unwanted momentum. But the flywheels could store up only so much energy before they too had to be "unloaded" by a thruster firing in the opposite direction. And heavy use of the reaction wheels required the spacecraft to fire its thrusters 10 times more often than the navigators had expected.

Every time the thrusters fired, the navigators calculated the spacecraft's change in trajectory. But because of a pro-

cedural mixup that began with a parts subcontractor, the calculations used English units instead of metric. The firings were actually more than four times stronger than they should have been, pushing the spacecraft slowly and steadily off course. "Even very small thrusts over time can really add up," explains JPL's Watkins.

Wandering off course should not in itself have spelled disaster. But in this case, the other essential ingredient of space navigation—precise tracking—also broke down. Navigators typically keep track of a spacecraft just as Farquhar's team follows NEAR: by watching the Doppler shift in its signal. But this method only measures the distance in one direction: along the line of sight between Earth and the spacecraft. It does a poor job measuring the spacecraft's motion out of that line, which unfortunately was the direction of the Mars orbiter's error.

Had the spacecraft been carrying a camera during its final approach, it would have been obvious from the photographs of the Martian moons that the craft wasn't where it was supposed to be. But photography wasn't one of the mission's scientific objectives, and cameras were left behind as an unnecessary luxury. Cost considerations also had led NASA to allow a supplementary tracking system known as VLBI (Very Long Baseline Interferometry) to fall into disuse. If the navigators had had the giant VLBI antennas on opposite sides of Earth, they could have used triangulation to fix the spacecraft's position in three-dimensional space. But



only the line-of-sight Doppler tracking was available, so mission control didn't know the craft was off course until it was effectively too late.

"It should have been a slam dunk," says Steven Synnott, a spacecraft imaging expert at JPL. "It should have been, but it wasn't."

The loss of the Mars orbiter was a crushing blow for JPL's navigation section. As missions had grown more precise and ambitious, navigation had always kept up. Until now. "You have the impression that navigation is a floundering science," sighs Standish, the planet-tracker. "It's not. It's a precise science, but you've got to have the right numbers."

You also have to be honest about what you don't know. When a team of engineers at JPL was plotting a proposed mission to Neptune several years ago, they wanted to know the planet's exact distance from Earth so they could calculate how long the trip would take and, consequently, how much fuel they would need. Standish gave them the distance plus or minus 400 kilometers, or about 250 miles.

"They wanted it more accurate than that," he recalls. "I said, 'No—400 kilometers is the best I can do.' You've got to plan your strategy on the fact that the distance to Neptune is not going to be known much better than that. Otherwise you're fooling yourself."

In the wake of the Mars Climate Orbiter loss, JPL assigned a kind of navigational SWAT team to make sure that the Mars Polar Lander did not go awry as well. Among other fixes, the team drew on a newly opened NASA checkbook to resurrect the VLBI tracking system, which helped navigators keep the lander on course for its target. In the end, they got the directions right. But an unrelated problem with the software that controlled the lander's descent through the atmosphere led to an embarrassing crash on Mars.

Even if these kinds of disasters can be avoided, the future of space navigation may lie not in better calculations on the ground but in teaching spacecraft how to find their own way. Auto-navigation will be particularly important for small, distant targets whose coordinates aren't well known from ground observations. Deep Space 1, a pioneering spacecraft launched in 1998 to test new spacecraft technologies and (as a bonus) encounter two asteroids, carried such a system. It was supposed to pick out its targets against a background of stars stored in onboard memory, then fly past them without any direction from the ground or independent tracking. NASA hailed the \$152 million project as a success because it proved other technologies, including an ion drive engine. But that wasn't the whole story: One asteroid proved too dim for the camera to recognize, a failure that scotched the auto-navigation experiment. To home in on your target, it helps to be able to see it.

*Chagrined MCO managers learned—after their spacecraft disappeared at Mars—that the erroneous use of English rather than metric units had doomed the mission from the start.*



AP/DAMIAN DOVARGANES

The navigators in charge of NEAR intend to make sure they don't lose track of their whereabouts at Eros. In a back room at JPL, astronomer William Owen uses the spacecraft's detailed photographs of the asteroid to create computerized maps of the nearly 1,200 craters that pock Eros' surface. Navigators will use the craters as road markers to identify where the orbiting spacecraft is and what part of the asteroid it's looking at. Automating the system is a worthy goal for the future, but for now it would demand too much computer power, says Owen. So he maps the craters by hand. "The eyeball is still a wonderful computer," he says.

Back at NEAR's mission control in Maryland, Farquhar's attention is focused on the numbers on the screen that tell him the spacecraft has begun firing its thrusters to lower its orbit. For a space navigator, this is the critical moment. Finally the numbers begin climbing, registering the signal's gradual Doppler shift, which means the craft is dropping closer to the surface.

"This is too easy," Dunham says.

"Well," says Farquhar, smiling now, "it's easy after you've done all the work."

When the spacecraft hits a preset velocity, the thrusters shut themselves off. Soon the tracking data comes back: NEAR has hit its marks perfectly, and is now nestled into the desired close orbit. Farquhar and the rest of his mission team can sit back and relax. For now. —

HAD THE SPACECRAFT BEEN CARRYING A CAMERA, IT WOULD HAVE BEEN OBVIOUS FROM THE PHOTOGRAPHS THAT IT WAS OFF COURSE.





# HOME by Nan Chase GROWN

ONCE SWALLOWED WHOLE BY TWA, LOCAL MISSOURI FAVORITE OZARK AIR LINES FLIES AGAIN.

**O**n this steamy August afternoon in mid-Missouri the temperature and humidity are both stuck at 95—it's a wonder anyone can move at all. Yet the moment Ozark Air Lines Flight 111 from Chicago's Midway Airport touches down at Columbia Regional Airport, there's Brad Fraizer looking cool as a cucumber, and he's in a hurry.

Dressed in a crisp white shirt, black slacks, banker's shoes, and tie, Fraizer doesn't even seem to be perspiring as he and his crew of one begin their 20-minute round of duties: stocking the galley, dumping the lavatory, loading luggage, swabbing the windshield, and boarding passengers. He's too focused to sweat the weather. Fraizer is direc-

tor of airport operations at Ozark, a year-old startup with a more-than-50-year-old name and, according to more than a few passengers, an inherited legacy of friendly Midwestern service.

But now there's a problem in the cabin, a bit of a passengers' revolt aboard the new 32-seat Fairchild Dornier 328JET. The flight attendant has opened the door and deployed the steps, but no one is getting up from the seats.

"I don't want to get off," sighs lanky Ron Watts, who has just returned home to Columbia with his wife, Teri. He's enjoying the air-conditioned chill, the expanse of legroom, and his wide leather seat, even the new car smell of the interior of the new jetliner. Ozark has just become his airline of choice, and he

wants to linger for a few more minutes in the unfamiliar luxury.

Across the aisle Michael Shirk is smiling as he gathers up some papers. As chairman of Columbia's Chamber of Commerce, Shirk was one of the city's business leaders who worked to get funding for the airport improvements that were necessary before Ozark Air Lines could begin operations last year. For Shirk—as for much of Columbia's business community—Ozark's success in the years to come will be important in helping the region grow.

Inside the low-slung brick terminal, big John Evans, Ozark's manager of sales and marketing, is critically eyeing a plate of doughnuts and flask of coffee set out near the ticket counter.





**OZARK AIR LINES**

DESTINATION  
DC  
FLIGHT/PA  
684/2

*Opposite, clockwise: Kathy Ekl (whose father also flies for Ozark) and Randy Eckley prepare to pilot a Fairchild Dornier 328JET. Missouri Senator John Ashcroft, the late Governor Mel Carnahan, Columbia Mayor Darwin Hindman, and Ozark chairman Wes Stricker (left to right) on launch day. The old Ozark also flew Fairchilds: FH-227s on local routes. Stricker (above, left) and John Ellis founded Ozark to serve a heated-up mid-Missouri economy.*

It's a homey touch, but that's okay. He wants the new Ozark Air Lines to be homey too, just like the airline of the same name that folded in 1986. Evans should know: He's the only current employee who worked for the old Ozark a quarter-century ago, and having a chance to work for the new Ozark is a dream come true.

"February 21 [the date of the new airline's first flight] was probably the most exciting day of my life," says Evans. "I know that sounds silly, but to see those green and white swallows [the Ozark logo] flying again.... You know, they stand for the swallows of Capistrano, and they're on time."

The genial gray-haired Evans grew up in Atlanta as the son of an Eastern Airlines pilot. Evans himself wanted to follow in his father's footsteps, but his poor eyesight prevented that, so he became an Eastern ticket agent in the early 1970s—just in time to get furloughed. He went back to school at Embry-Riddle Aeronautical University in Daytona Beach and in 1976 was hired by Ozark as a station agent in Clarksville, Tennessee. He was devastated when he heard whispered reports that the airline was about to be bought by TWA.

He could have stayed with TWA, but would have had to relocate and derail his wife's career.

"[The old Ozark] was small enough that the people cared," Evans says. "If I had a problem with a customer, a travel agent, I could pick up the phone and talk to the president of the company and he would take care of it. We were a safe carrier, it had a good reputation, it was profitable," Evans says. "People come in and say they remember the old Ozark."

Ozark also prided itself on its inflight service, which included food served from restaurants around the country and an extensive wine list on select flights. But the airline wasn't always high-brow. "For lunch it might be a hoagie and Mateus," Evans says.

Even though Evans is the only holdover, fondness for the old airline runs deep. "You can talk to anybody who lives in the Midwest and they've flown on the airline," William E. Boston III, manager of Columbia Regional Airport, says of the old Ozark. Boston is a sandy-haired, decorated veteran who flew combat missions in Vietnam. Some call the retired U.S. Air Force colonel Bill, others call him Boss, short for Air

Boss, because he served in that capacity at Columbia's annual Memorial Day airshow, a volunteer post he held for eight years. In addition to his other accomplishments, Boston is proud to be a "veteran" of numerous flights on the old Ozark.

Such nostalgia is a result of the loyalty that many now-defunct regional airlines inspired among the communities they served, often for decades. The Ozark name has been in the air on and off since 1932, when a short-lived operation flew Stinsons between Kansas City and Springfield, Missouri. An unrelated Ozark—destined to become the airline fondly remembered by Evans and Boston—flew from September 1943 to November 1945, then languished during a period of confusing post-war regulation aimed at controlling exploding commercial air routes. Ozark didn't reorganize again until September 26, 1950, when it flew a single passenger on an inaugural DC-3 flight between St. Louis and Chicago.

Ozark grew rapidly, adding a succession of cities to its route map in the 1950s. By 1959 it was modernizing its fleet with turbine-powered Fairchild-Hiller FH-227s. But even though Ozark





*Ozark's new aircraft are almost as young as the airline. The Fairchild Dornier 328JET—an all-jet-powered version of the successful 328 turboprop—first flew in 1998. Its speediness makes it a good choice for small airlines like Ozark, enabling them to hustle passengers to regional hubs like St. Louis or Dallas-Ft. Worth. Today, Ozark's pilots (bottom) are flying many of the same routes their predecessors did while criss-crossing the Midwest in DC-3s (top).*

passengers could ride new Douglas DC-9s in 1966 between hubs like LaGuardia Airport, St. Louis, or Chicago, they could still climb into a rumbling DC-3 to get to Peoria, Ottumwa, or Kirksville. Eventually, Ozark became a thoroughly modern airline flying the Douglas twin jets exclusively. The carrier became so proficient in DC-9 upkeep that in the 1970s, its St. Louis maintenance facility overhauled Air Force C-9s (a militarized DC-9), and even overhauled Hugh Hefner's DC-9, which was resplendent in gloss-black paint and a Playboy-bunnied tail.

But deregulation in 1978—and the elimination of the Civil Aeronautics Board that had begun approving Ozark's routes in 1950—spelled trouble ahead for many regional airlines. Ozark (which by the mid-1980s was carrying more than 5.5 million passengers a year) and its peers like Piedmont Airlines had grown rapidly. Without regulations that protected their routes from the larger carriers, the regionals found themselves competing directly with the big boys. The end finally came on October 26, 1986, when Ozark was absorbed by Trans World Airlines. Jet service disappeared in Columbia, which became

a Trans World Express town, served by a handful of daily turboprop commuter flights.

"In 1978, when the airline industry deregulated, that's when smaller communities started to suffer," Boston says. "In Columbia, 67,558 people enplaned here in calendar 1978, more than the population of the town at that time. In 1986, another peak year, the year Ozark was bought, there were 60,000.... Then the assets were pulled out, and routes changed a lot."

Columbia Regional, which is owned by the city, is a 15-minute drive from town through a lush, undulating landscape of field, forest, and cream-colored rocky bluffs. When the original St. Louis-based Ozark was flying, the airport prospered; when it stopped flying, the airport businesses started to dry up as the passengers disappeared (even as the privately owned general aviation fixed-base operations got busier).

The numbers declined steadily throughout the late 1980s and fell to a "devastating" 32,740 in 1991, Boston says. In 1994 there was a sharp increase thanks to service by Lonestar, a Texas feeder that flew to and from Dallas, but after that airline left the scene fewer

and fewer passengers used the airport, which reached an all-time low of 24,537 passengers in 1999.

Boston knows the numbers backward and forward and what the patterns mean for Columbia, an adopted hometown that he and many others love for its charming combination of big-city attractions—a highly-regarded state university, top medical facilities, a booming economy—and small-town warmth and convenience; the population is about 80,000 and boasts a community of several hundred retired military folks.

After Ozark disappeared in 1986, the only alternative to riding a TWE Jetstream 31 turboprop to the St. Louis airport was to travel those same 100 miles on I-70, labeled by state officials as one of the most dangerous roads in Missouri. Because TWE's Columbia service can be delayed whenever the weather at Lambert-St. Louis International Airport gets sloppy, many people make the roughly two-hour drive instead.

"The airport's biggest competition is the interstate highway," Boston explains. "Most people have come to an automatic thinking that you have to go to St. Louis to get anywhere."





*Hungry? Inflight  
meals on the  
old Ozark some-  
times featured  
"a hoagie and  
Mateus."*



OZA

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time

*Ozark settled into some of the same counters at Columbia Regional Airport that its namesake had abandoned almost 25 years earlier after being absorbed by Trans World Airlines (left). Since Ozark started flying again, 40 percent more passengers are traveling from Columbia to destinations like Chicago's Midway Airport, where a fire truck greeted the inaugural flight with a stream of water across the taxiway (right).*

In short, getting anywhere from Columbia by air—or into Columbia, an important business consideration—took a lot of time.

Enter Wes Stricker, a 46-year-old physician, pilot, aircraft collector, and native of Missouri. "About three years ago I was coming back from Chicago and it struck me that it was just so hard to get there from here," says Stricker. "We had a lot of business that had trouble getting to us. It just hit: We need a scheduled service to Chicago. No one else seemed to have an idea to do it." Today, his company's jet service to Chicago takes less than an hour; to Dallas-Fort Worth, just two.

"The word on the street was that you couldn't start an airline in today's environment," says Stricker. "The FAA... gave us a lecture that only a very small percentage of people who applied for the air carrier certificate ever received it. It was a very dismal percentage."

Stricker tapped 60-year-old John Ellis to become president of Ozark. Both men are Missouri natives, stubborn believers in Midwestern values like hard work and patriotism and community spirit. Stricker, a doctor's son, worked his way to wealth as an allergist: To-

day he oversees six allergy treatment clinics in small Missouri towns and six research facilities that test drugs for FDA approval. Ellis and Stricker participated over the years in Columbia's Memorial Day Weekend Salute to Veterans Celebration, a huge airshow that takes over the town for a few days every year. Both men perform—Ellis flies a Grumman F7F Tigercat, often in formation with a Navy F-14, and Stricker flies his P-51 Mustang.

Stricker's Mustang is part of a collection of more than a dozen aircraft, including a Czech L-39C Albatros jet trainer, and an elegant Piaggio P180 Avanti. He still has his first airplane, a wreck of a Piper J-3 Cub that he and his younger brother bought as teenagers with money they earned hauling hay and then rebuilt themselves over three years. And, yes, he even flies the line for his own airline occasionally. (Stricker's wife, Pam, is a flight attendant for Northwest Airlines, usually on the Minneapolis-to-Paris route, and their young daughter has already spent hundreds of hours in the air.)

John Ellis graduated from the University of Missouri in 1962 and served as a Navy fighter pilot until 1967. Then

he founded Kal-Aero, a Michigan fixed-base operation for major aircraft servicing and custom modifications; when he sold the company in 1998 the firm had 350 employees and revenues of \$40 million. Along the way he became a member of the Society of Experimental Test Pilots and was inducted into the Warbirds Hall of Fame. For relaxation he likes to ride one of his Harley-Davidson motorcycles.

To gauge interest in a new airline, Ellis bought a mailing list of key business leaders in the Columbia and Jefferson City area and sent them a survey requesting detailed information on travel habits and preferred destinations. The results uncovered a huge pent-up demand for reliable regional air service out of Columbia—especially to Dallas and Chicago—but not with turboprop-powered commuter aircraft. "If the airplane had propellers on it we wouldn't achieve what we wanted," he says.

A perpetually smiling Columbia native named Mary McCleary Posner quickly earned a spot as head cheerleader and behind-the-scenes matchmaker between Ozark, the city of Columbia, and the rapidly expanding business market the new airline soon hoped to serve.



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table

COLUMBIA MISSOURIAN FILES

OZARK AIR LINES

Flight 101

Departs 8:00

COLUMBIA

*"The word on  
the street was  
you couldn't  
start an airline  
in today's  
environment."*



Starting with the airline's birth in 1950, Ozark flew DC-3s to the smallest of its destinations until 1968, even as it was flying modern DC-9s between hubs. First-flight perks on the new Ozark included champagne served by director of inflight services Tiffany Fortin (right), but passengers often find more homey fare—coffee and doughnuts—welcoming them to Columbia, where the airline is housed in a new 22,000-square-foot-hangar and office facility.

In the process of organizing the airshow—to replace the previous Memorial Day festivities that she called “three old men gathered at the courthouse for speeches”—Posner also put together a huge network of Columbia business people who were attuned to the local airport and the desirability of a local airline.

A contemporary of Ellis, she had left Missouri and headed to New York City as a young woman, but instead of becoming a college teacher as she had hoped, Posner went into advertising and stayed in the Big Apple for 25 years. When she returned to Columbia with her husband in the 1980s she remained active in promotions and marketing. Today, she serves as Ozark's Director of Corporate Communications.

Going into the FAA certification process, Ozark Air Lines and the city of Columbia needed each other badly. “We're screwed if we don't have an airline like Ozark,” says Mike Shirk, who besides running Columbia's Chamber of Commerce serves on the board of directors of Boone Hospital Center. “We are always in the top five or ten places to raise kids, do business, et cetera, but we're not going to be a se-

rious contender until we have our own airline. Ozark's startup has allowed us to send recruitment letters to Dallas and Chicago and all points in the world after that.... It was a shot in the economic arm.” Shirk has increased the out-of-town per-diem rate for hospital staff—as long as the travelers buy tickets on Ozark instead of taking the long drive to the St. Louis airport.

As much as Ozark promises to help the Columbia business community, the nascent Ozark Air Lines needed help in financing such airport improvements as a new apron and site preparation for what would become a spotless, all-white 22,000-square-foot hangar plus offices. City leaders set to work with unprecedented zeal to find grants and begin the startup process.

Bill Boston was a key link. With his assistance the city got plenty of help from the FAA regional office in Kansas City, which rushed crucial federal grant applications for Ozark through Congress during an auspicious cycle of appropriations. “When I called those guys and said, ‘I've never done this,’ they talked me through the process,” Boston says. “We did things that airlines would take two, three, four years to do typi-

cally, and we did it in 18 months. A lot was expected of the community, the city, and a lot of other people to cooperate in the process of starting an airline. I learned a lot very fast.”

Besides getting a certificate of convenience from the U.S. Department of Transportation—proof of financial responsibility—Ozark had to work through an added layer of bureaucracy: It was one of the first passenger carriers to go through the beefed-up FAA certification process instituted after the well-publicized 1996 ValuJet disaster, in which oxygen canisters in a DC-9 cargo hold caught fire and the jet plunged into the Florida Everglades.

In January 1999, when the certification application was filed, it was time for Ellis to hire the FAA-mandated startup staff—a director of operations and a chief operations officer, a chief inspector, a director of safety, a chief pilot, and a director of aircraft maintenance. A lot of money went out but none was coming in; Ozark couldn't even advertise until it had the certificate in hand. In fact, for months the whole operation was hush-hush. Wes Stricker put \$3 million of his own funds into the airline.





***"I never thought I'd have the opportunity to live back here..." says Ozark pilot Randy Eckley, who got to settle near his extended Missouri family. "I'm flying a wonderful airplane, and I'm here at home helping my son with his homework. I'm home every night."***

**OZARK AIRLINES**

DESTINATION  
DCA  
FLIGHT/DATE  
684/29

*A ground crewman guides an Ozark flight on its last few feet—in a few moments the ramp crew will be cleaning the cabin, unloading luggage, washing the windscreens, and stocking the galley for a new passel of passengers. The airline pledged 21 new jobs to the mid-Missouri community, but delivered 75. One new hire is a veteran of the old Ozark, who provides a living link between the airline's homespun history and its (so far) promising future.*

Another wrinkle: Stricker and Ellis had chosen an airplane so new that it wouldn't be certified until July 1999. When they realized they would need a small jet for Ozark the choices were few. Two likely candidates, the Embraer ERJ-145 and the Bombardier RJ 200, already served a number of feeder airlines but were too big for Ozark. That left one contender, the \$12.5 million German-built Fairchild Dornier 328JET, a turbofan-powered version of the 328 turboprop commuter airliner. The comfortable aircraft proved to be a perfect fit with passengers, pilots, and the folks who pay the fuel bills. Ozark currently owns two 328s but there may be up to 10 more on the way in the near future.

Almost everyone involved in the certification process describes it as...well, they all take a deep breath and say "boot camp." The workday stretched to 12, 16, even 24 hours as the management team developed the airline's operations manuals. Then they had to train their new employees and lead them through a series of FAA-mandated proving flights to make sure not only that all safety procedures were in place and the employees were well-trained but that each

segment of the airline knew just how to work with all the others.

Wes Stricker says, "To a man, the motivations have not been financial for the airline." The certificate came on February 11, 2000, and 10 days later Ozark Air Lines took to the air. The airline pledged to bring 21 new jobs to the airport; so far, the tally is 75. The motivations included pride in a business community ripe for a reliable, direct jet link, a desire to revive the airport, and nostalgia for the old Ozark's local-flavored service, all of which bound the airline tightly to the community from the first tentative steps until the first flight took off for Chicago, on February 21.

There's no better illustration of Ozark's deep local roots than 44-year-old Captain Randy Eckley. A job with Ozark allowed him to settle down near his extended family outside of Columbia after an Air Force flying career that took him to Korea, Saudi Arabia, Kuwait, Italy, and the Pentagon.

In 1998, at a family wedding in Missouri, his newspaper-owner in-laws told him about the coming startup of Ozark Air Lines, but there was no job yet for Eckley. Instead, he kept his flying skills

fresh serving as a pilot for Continental Express. In July 1999 Ozark called.

"I always wanted to come back here," he says. "I never thought I'd have the opportunity to live back here as a pilot. For me it was a dream job. I'm flying a wonderful airplane, and I'm here at home helping my son with his homework. I'm home every night."

Ozark also features the father-and-daughter team of Jack and Kathy Ekl. The elder Ekl is a former U.S. Navy Blue Angels pilot with 27,000 hours of jet time in both the Navy and Air Force Reserve; he passed his love of flying on to his daughter, who started flying at age 15.

Since the new Ozark began operations, Boston says, 40 percent more passengers are using the airport and revenues are "way up." Ellis says he fields calls almost every week from other cities that want Ozark jet service.

Perhaps that's the beginning of an inevitable cycle: As the old Ozark grew and added more sophisticated aircraft, it first served—and later shed—some of the same towns. But for now, Missourians are watching the rise of their brand-new line, equipped with the latest aircraft and a hometown smile. —



*From the Arc Light missions in 1965, when B-52Fs attacked targets in South Vietnam, to the 1972 Linebacker campaigns, the B-52 became a symbol hated by the North Vietnamese.*



**BY MARSHALL MICHEL IN DECEMBER 1972, THE B-52 BOMBERS THAT NORTH VIETNAMESE MISSILE CREWS HAD BEEN WAITING FOR CAME TO HANOI. NIGHT AFTER NIGHT. OVER VIRTUALLY THE SAME TRACK.**

**L**ast year in a small theater in Vietnam's Bas'tang Cheu Thang B52—B-52 Museum—I watched a re-creation of the last U.S. bombing campaign of the Vietnam War, staged on three video screens and a large lighted terrain map of 1972 Hanoi. As a soundtrack of martial music accompanied by the noise of explosions and anti-aircraft fire filled the theater, the screens showed surface-to-air missiles blasting off into night skies and B-52s falling in flames. Flashing lights on the terrain map indicated where bombs hit and B-52s crashed. The video, interspersed with pictures of North Vietnamese leaders touring bombed-out buildings and giving encouragement to anti-aircraft crews, ended with a voiceover, translated for me by my Vietnamese guide: "The Dien Bien Phu in the skies, the 12 days and nights victory over the B-52s...is always the pride and spiritual strength of the good-willed and wise Vietnamese people...."

I had come to Hanoi to research my second book about the air war over North Vietnam: the story of the December 1972 B-52 bombing of Hanoi, known as Linebacker II. I had arrived with the standard U.S. understanding of the raids. In early December 1972, President Richard Nixon and his national security advisor, Henry Kissinger, faced a political defeat. The North Vietnamese had broken off negotiations in Paris. It was clear that they were waiting for an anti-war U.S. Congress to return in January, cut off funds for the war, and give them a victory.

To force the North Vietnamese to sign the agreement, Nixon decided to bomb Hanoi. After initial heavy U.S. losses, B-52s were able to attack with relative impunity and, after 11 days of raids, the North Vietnamese returned to Paris to sign the agreement they had rejected in December.

But now, after a few days in Hanoi, I saw that the North

Vietnamese had a different perception of the bombing. They considered Linebacker II the final Vietnamese victory over the United States, a victory on the scale of the battle that had forced the French from Indochina. I had come to the museum to try to resolve these dual and dueling images of a battle, and I left with my questions unanswered.

I exited the museum through a courtyard where broken B-52 pieces and parts had been piled in a heap about 20 feet high. Nearby were two SA-2 missiles on launchers, a Fan Song tracking radar, and the control van where missile crews tracked incoming bombers and tried to shoot them down. As I walked between the pile of B-52 parts on one side and the control van on the other, it occurred to me that the combatants fought in similar circumstances: six men in the cramped crew compartment of a B-52 targeted by the seven-man team enclosed in an SA-2 control van.

**O**n Friday, December 15, 1972, Captain Bob Certain and the rest of his B-52G crew at Andersen Air Force Base in Guam were notified that all crew rotations Stateside had been suspended. It was a bitter blow. The crew members had been preparing to return to Blytheville Air Force Base in Arkansas on Monday, and this was another setback; they had been scheduled to return first on December 4, then on December 12. It was especially frustrating for Certain's aircraft commander, Lieutenant Colonel Don Rissi, who was in line to become the new squadron commander once Stateside.

In an unpublished memoir, Certain, a B-52 navigator, recalls how he and his crewmates reacted: "The crew's first thought—and hope—was that the war was over and we were being held on Guam to bring all the planes back to the



# THE XMAS BOMBING

U.S., but a quick tour of the flightline on Saturday morning and we saw all the B-52s were being refueled and loaded with bombs." (The full memoir is at [www.airspacemag.com](http://www.airspacemag.com).)

When Certain's crew entered the briefing room at 11 in the morning on Monday, December 18, it was packed with over a hundred crew members. In a scene that seemed right out of the World War II film classic *Twelve O'Clock High*, the briefer came to the podium and announced, "Gentlemen, your target for tonight is Hanoi," as a slide of North Vietnam with a target triangle over the capital lit up the screen behind him. This was the first time the big bombers would be sent against Hanoi's heavy defenses.

Nixon had ordered the raids on December 14, and the Strategic Air Command headquarters in Omaha, Nebraska, hastily devised a plan. The Eighth Air Force staff on Guam was surprised at the SAC decision to plan the missions in Omaha. The Eighth's mission planners had managed B-52 raids for years, and, since they were stationed on Guam, could discuss tactics with many of the B-52 crews. The distance between the SAC planners and the combat crews halfway around the world seemed to guarantee problems



In the fall of 1972, the 77th Missile Battalion trained to defend against an attack on Hanoi. When the attack came, the 77th downed a B-52.



SAC's plan was to split the B-52 force—which would be flying from Guam and a U.S. base in U-Tapao, Thailand—into three waves, all attacking at night, with four hours between each wave. The bombers would fly almost identical routes, in single file, to Hanoi.

Captain Jim “Bones” Schneiderman, a B-52 copilot who attended the first briefing, was not impressed. “It was clear before we even took off on the first mission that the tactics were really dumb, everybody coming in from the same direction, same altitude, same exit routes,” he says. “It was so much like the image of the British in the Revolutionary War—all lined up, marching in straight rows making easy targets—that it was bizarre.”

**E**ven for the northeast monsoon season, the early evening of December 18 was exceptionally cold and rainy in the small village of Nghe An on the western edge of North Vietnam. Dinh Huu Than, the commander of the 45th Radar Company, 291st Radar Regiment, Vietnamese People's Army Air Defense Corps, was just outside the village, serving as the first line of the North Vietnamese early warning system. Than and his crew were hunched over the scopes of their Soviet-made P-12 early warning radar when a line of blips appeared, proceeding

north in a stately procession up the Mekong River, which divides Thailand from Laos. The blips were surrounded by heavy static, and from the jamming patterns Than and his company knew that the blips were made by B-52s, America's largest strategic bombers, some capable of dropping 30 tons of bombs. The 45th's operators had seen B-52 returns many times before, but never in this number, and they watched transfixed as the blips moved up to Point 300, the point where the B-52s normally turned west to bomb targets in Laos or east toward targets in the North Vietnamese panhandle.

But tonight the B-52s moved past Point 300 and continued north. Than suddenly realized that they were following a course that many U.S. strike aircraft used when they attacked Hanoi. He watched the returns for a few seconds longer, then at 7:15 in the evening Hanoi time, he sent a

message to his regimental headquarters: “Large numbers of B-52s have flown past Point 300. B-52s appear to be on a course for Hanoi.”

The regiment quickly forwarded the message to the Air Defense Command Headquarters in Hanoi. After a delay of a few moments, Than was asked to repeat the message. The last U.S. battle of the Vietnam War was about to begin.

Than and his radar crew were part of a North Vietnamese air defense radar network that covered the whole country in depth, but the radars were cobbled together into a manual system that had difficulty dealing with multiple raids or a rapidly changing situation. Than's information about the raid went to the Air Defense Command Headquarters. The

hub of the headquarters, a large amphitheater, was dominated by a large transparent map overlaid with a grid. On one side of the map sat the air defense staff with telephones connected to all missile units. On the other side, a team of plotters marked the progress of the raid on the map, and as the aircraft moved, the positions were called out to them by officers tracking the flights on early warning radars. The plotters wrote the information backward so it could be read by the air defense staff on the opposite side.

The Hanoi region was the responsibility of the 361st Air Defense Division. The division had numerous radars and anti-aircraft guns, but its heart was three SA-2 Guideline regiments: The 261st Regiment was responsible for the area north and east of the city, while the 257th and the 274th Regiments covered the south and west. Each regiment had a number of early warning radars and was assigned three SA-2 missile battalions, each one

equipped with its own early warning radar, a Fan Song missile guidance radar, and six SA-2 missile launchers.

The SA-2 Guideline system had been used for the entire war but had achieved mixed success against highly maneuverable U.S. fighters. Overall, the system was reliable but unsophisticated, using vacuum tubes and slow, mechanical computers, and the Fan Song guidance radar had proved vulnerable to various types of electronic jamming. The success of the system depended almost entirely on the skill of its seven-man crew.

The experienced Hanoi missile crews had been defending against U.S. air attacks for years, and they were especially anxious to shoot down a B-52. The big bombers had devastated North Vietnamese forces at Khe Sanh and recently pummeled North Vietnamese units fighting elsewhere in the south. North Vietnamese experts had been studying



VIETNAM NEWS SERVICE

*Anticipating a B-52 raid, missile crews refined their tactics. Their weapon, the SA-2 Guideline, displayed today at a Hanoi museum, carried 130 pounds of explosives in its warhead.*



GEOFFREY CLIFFORD



the B-52s' standardized tactics and jamming procedures almost daily as the aircraft attacked targets in Laos and southern North Vietnam, and at an October 1972 conference the Hanoi missile battalion commanders reviewed hundreds of feet of Fan Song and Spoon Rest radar film of B-52 jamming, provided primarily from units in southern North Vietnam. After that conference, the air defense headquarters produced a book entitled "How to Fight the B-52" and distributed it to all the SA-2 units.

**W**hile the weather on the ground was cold and rainy, above the solid cloud deck it was a beautiful night, with clear skies and a full moon that reflected on the clouds. U.S. support forces shepherded the B-52s in. The strike package included F-4s—some dropping strips of metal foil, or chaff, and others acting as fighter escorts—EB-66 electronics jamming aircraft, and the much-feared Wild Weasels, aircraft specially configured with electronics and the anti-radiation Shrike and Standard ARM missiles, which could home in on the SA-2's Fan Song radar (see "Counterpunch," Aug./Sep. 1998). As the force approached Hanoi, low-flying FB-111 fighter-bombers attacked North Vietnamese MiG airfields. The B-52s followed in three-ship cells.

At the command post plotting map, Dong Thi Van, one of three women who worked as plotters in the headquarters, became very nervous as the B-52s approached. "At first...one flight, then two flights, then several flights com-

ing like a swarm," she recalls, "but my soldier's sense of responsibility helped me regain my composure and continue to plot the flights." The 361st Division headquarters watched the raids approach, then began to allocate numbers to cells of bombers and assign them to the battalions to attack.

The missile crews had been alerted that the B-52s were inbound, and trucks in the missile sites had long since started up their noisy diesel engines to provide power to the radar and command vans, each about the size of an 18-wheeler. The un-air-conditioned command van was the heart of the SA-2 battalion. Inside the van were the battalion commander, a fire control officer, three guidance officers, a plotter, and a missile technical officer, who was responsible for monitoring the status panels of each of the six launchers and their missiles. The battalion commander was in phone contact with the regimental headquarters and sat in front of the radar scope of a Spoon Rest acquisition radar, where he watched the raids come in while waiting for orders assigning the battalion a target. Next to him was a transparent plotting board showing his battalion's area of responsibility, overlaid with the same grid references as the map at headquarters, and standing behind it was the plotter, also connected by phone to headquarters. When the battalion was assigned a target, the commander located the aircraft with the Spoon Rest search radar while the plotter tracked the raid manually on the plotting board; this process ensured that, if jamming prevented the battalion com-

## The Brains Behind the SAMs

**T**he Fan Song tracking and fire control radar uses two trough-shaped antennas mounted on a steerable platform atop a van. The vertical antenna emits a narrow fan-shaped beam that sweeps up and down through an arc of 10 degrees about 15 times a second; its return provides the target's elevation. The horizontal antenna emits a beam that sweeps as rapidly side to side; its return provides the target's azimuth. The beams pulse to determine range; the time between a pulse's transmission and its return indicates the distance to the target.

At a typical engagement range, 10 miles from the radar, the beams scan an area of sky about two miles square.

A firing computer receives the radar returns from the tracking antennas and can either guide a missile by using the returns or compute a point in the sky ahead of the target where a missile can intercept it. After launch, the missile's transponders communicate with the computer, which continuously sends guidance instructions by C-band radio signals from a parabolic antenna also mounted on the van.

The North Vietnamese used VHF search radars with ranges well over 100 miles to warn their defenses of incoming bombing raids. Targets would first be picked up by the search radars, which gathered data on range and azimuth, and the information would then be handed off to the Fan Song tracking radars, which could sweep only a narrow area of the sky.





mander from locating the assigned target on his radar scope, he could watch the target's position and course on the plotting board and determine when he could begin the engagement.

The fire control officer sat a few feet away on the commander's extreme right; in front of him was a Fan Song radar scope that he used to locate and track the target. In front of him the three guidance officers—each one responsible for one coordinate (elevation, azimuth, and range) of the missile—had radar scopes with large control wheels beneath them. The officers turned the wheels to keep crosshairs on the target's radar return.

The van was tightly sealed to keep out light so the operators could focus on their radar scopes, and the only sound other than the voices of the crew was that of loud cooling fans, necessary to control the temperature of the vacuum tubes in the relatively primitive electronics of the SA-2 system. "The background noise of the fans was not a big problem," recalls a battalion commander who asked not to be identified. "It was quite noisy, but you got used to it. The tone of voice set the tone for the crew, and each battalion commander had his own style, based on his personality and how he trained his crew."

**T**he first B-52s flying into North Vietnam that night were a group of 21 from U-Tapao, Thailand. The 28 B-52s from Andersen fell in behind, and the 49 bombers moved single file from the northwest corner of Vietnam down to the southeast toward Hanoi.

"As we turned eastbound out of Laos to enter North Vietnam for the bomb run," Bob Certain recalls in his memoir, "we were all focused on making this the best, most accurate mission we had ever flown. We would be in lethal range of SAMs [surface-to-air missiles] for about 20 minutes, but we couldn't be distracted by the threats. The radar navigator and I turned off our exterior radios so we could concentrate only on our checklists and crew coordination.

"We had been ordered to take no evasive action from the initial aiming point to the bomb release point. Those orders



VIETNAM NEWS SERVICE



GEOFFREY CLIFFORD (2)

*Kham Thien Street in Hanoi was obliterated in December 1972. Today a monument marks the site as the area of the city's heaviest destruction.*

the radar returns were buried in the bright, white fog of the jamming," he recalls. "The screens of the fire control officer and the guidance officers showed many dark green stripes slanted together, changing at abnormal speeds, one strobe overriding and mixing with another, this strobe joining that one and splitting away. After that, hundreds and thousands of bright dots specked the screens like bunches of target blips moving sluggishly. With all that mass confusion coupled with a constant blinking on the radar scopes that looked like a downpour of rain, how were we expected to distinguish between fighter jamming and B-52 jamming, or which was EB-66 jamming and which was the passive chaff strewn across the sky by F-4s?"

Soon the buildings and ground in Hanoi and the surrounding area, including the vans of the missile battalions, began to tremble slightly as the first bombs hit the MiG bases at Hoa Loc and Phuc Yen. The North Vietnamese Air Defense Headquarters pressed the battle watch commander of the 261st:

"Have you seen the B-52s yet?"

"Have any units opened fire yet?"

"Why haven't they opened fire?"

In their command vans, the North Vietnamese missile crews were trying to track the B-52s on their Spoon Rest acquisition radars by following the jamming strobes, rather than using their Fan Song radars because turning on the Fan Song signal would expose them to attack by anti-radiation missiles from Wild Weasels. But the passive tracking was not working—the jamming was too intense.

As the raid approached, Nguyen Chan, commander of the 78th Battalion, saw "wave after wave of jamming—looking like large blades of a hand fan overlapping and slanted—came together, wiping out the whole spectrum.... It was so bright it hurt the eyes.... [The returns were] twisted and coiled together into a clump like a tangled ball."

Chan had his Fan Song tracking radar in standby, and all



that was necessary was to press the Target Transmitter button and in four seconds the radar would be at full power. As the B-52s approached, Chan's search radar remained useless; watching his assigned target approach on the plotting board, he decided to turn on his Fan Song to look for the B-52s. There was considerable risk to this—the longer the Fan Song was on the air, the more likely it was to be attacked—but Chan took the risk and pushed the radar switch, using the range and bearing to the oncoming bombers, as plotted manually on the map, to point the antenna. Soon his fire control officer, Nguyen Van Luyen, was able to break out a single B-52 jamming strobe. Luyen put his crosshairs on the strobe and pushed the transfer button, and the target appeared on the scopes of the three guidance officers. The range guidance officer, Dinh Trong Due, excitedly called out "B-52!" and the three officers adjusted their range, azimuth, and elevation sets so the strobe was steady. Then they gently began to move their control wheels to follow the strobe.

Due continued to shout "It's really a B-52!" and Chan tried to quiet him so the crew would stay calm and concentrated. The jamming prevented the crew from going to the most accurate mode of the Fan Song, automatic track, but finally, at 7:49, Chan gave the order to fire; two buttons were pushed and, with their booster rockets burning brightly, two missiles climbed through the overcast toward their targets. The commander of the Hanoi Air Defense Force, Major General Tran Nhan, recalls that when Chan reported the firing to the 257th's regimental HQ, "sighs of relief could be heard at command headquarters from all levels."

One former North Vietnamese officer explained this phenomenon to me. "Firing back gives one a sense of power, a sense that one is fighting back and is not a passive victim," he said. "We gave everyone a gun and encouraged them to fire at American aircraft, no matter how far away. The people had to feel they were fighting back. We especially wanted the children in the air raid shelter to see their parents at the shelter entrance firing at the enemy."

A few miles north of Hanoi, Nguyen Thang, commander of the 59th Missile Battalion, was having a frustrating evening. The battalion had fired four missiles but all had missed, and dirt and gravel had showered down on the roof of the van from nearby bomb explosions. Now Thang was watching the raid approach both on his Spoon Rest radar scope and the plotting board next to the scope when he heard the call from the 261st's regimental headquarters alerting him to a target—T671—at an altitude of 10,000 meters.

Thang called to the fire control officer, Duong Van Thuan: "Target azimuth 350, distance 30 kilometers, altitude 10,000 meters, grouped."

Thuan manually turned the antenna to an azimuth of 350 degrees, then pushed the Target Transmitter buttons, and four seconds later the Fan Song radar was fully active. He saw heavy jamming on the scope, indicating a cell of three B-52s. He called back to Thang: "Target detected, azimuth 352, unknown range, altitude 10,000 meters, group, hostile."

Thang looked over at the fire control officer's radar scope, then back to his own, then at the plotting board, and ordered Thuan to prepare to fire two missiles. Although only azimuth and elevation were known, the third point—range—was easy to calculate. B-52s always flew between 30,000 and 38,000 feet. Finding range was simply a matter of elementary geometry: of using a side (altitude) and two known angles of a right triangle—90 degrees and the angle of the Fan Song's vertical beam—to calculate its hypotenuse.

Thang tracked the movement of the jamming strobe on the scope, and once the return was stabilized, he gave the order to the three guidance officers to take over tracking the target manually, a task requiring extraordinary skill. In a 1982 Vietnamese newspaper article, Thang described the problems: "It is difficult enough to guide the missiles manually under normal conditions in which the targets are clearly seen. It is even more difficult looking at the silky crepe [jamming] of the B-52 aircraft on the radar screen. An uneven rotation or a mere jerky movement of the control wheel could cause the missiles to deviate from the target by thousands of meters or even detonate in the air."

As the B-52 approached, Thuan fired two missiles, and the guidance officers focused even more closely on their scopes and guidance wheels. Then, 24 seconds after the missiles had been launched, a light on the control panel flashed, indicating the first missile's proximity fuse had gone off, followed by the flash of a second light. The azimuth guidance officer, Nguyen Van Do, called out that he had lost the strobe, followed by the elevation guidance officer, Le Xuan Linh, reporting that the target's jamming strobe was rapidly losing altitude.

**B**ob Certain's B-52, Charcoal 01, had almost reached the assigned target. In his memoir, Certain describes what happened next in the lower deck of the B-52's crew compartment: "The radar navigator, Major Dick Johnson, and I had suppressed all emotion to concentrate on this critical phase of the mission. Fifteen seconds before bombs away, we opened the doors, and five seconds later I restarted my stopwatch as a backup to the drop should

*77th Missile Battalion commander Dinh The Van (second from left) and three crewmen stroll near the Fan Song radar in the courtyard of the B-52 museum.*





anything go wrong. Almost immediately, it did.

"The radar screens went blank and other instruments lost power. My first thought was that the copilot, Bobby Thomas, had accidentally knocked the generators off line. Before I could speak, though, Bobby was shouting over the intercom, 'They got the Pilot! They got the Pilot!'

"The EW [electronic warfare officer], Captain Tom Simpson, was also shouting, 'Is anybody there? Gunner, gunner!'

"I looked over my left shoulder and saw fire in the forward wheel well through the porthole in the door behind me. My first thought was of the twenty-seven 750-pound bombs in the bomb bay right behind the fire, and I turned to the RN [radar navigator] and yelled, 'Drop those damn bombs!' He safetied them (we didn't know where they would land), and hit the release switch. They all seemed to drop away from our now-crippled B-52. My next thought was that the fire was also directly below the main mid-body fuel tank, loaded with 10,000 pounds of JP-4.

"Then aircraft commander Don Rissi's voice came weakly over the intercom. 'Pilot's still alive.'

"Figuring it was time get out of here, I called, 'Copilot, this is the Nav, escape heading is 290.'

"It was now about 10 seconds after the first of two SAMs hit the plane and I heard the call, 'EW's leaving!' as Tom Simpson ejected. I heard the explosion of his hatch above me and the boom from his seat as it rocketed up and out, but felt no decompression. I looked at the RN. Our eyes met, and we both started preparing for ejection. I threw my flight case as far to the rear of the cockpit as I could, grabbed the ejection handle, looked at the RN again, and then turned to face forward. I saw the ejection light come on showing the pilot ejected, and pulled the handle. The seat failed.

"At least, that's what I thought. The ballistic activators were supposed to blow the hatch below my seat and fire me out of the bottom of the plane in one-tenth of a second, but I was so scared that the panels in front of me seemed to be barely moving at first, then to move up in slow motion.

"The next thing I knew, I was tumbling in the cold air of the stratosphere, thinking, 'That was a dumb thing to do. I'll bet the plane was still flyable. Where is it? Maybe I can crawl back in.' A moment later, I felt the parachute opening. So far, so good.

"I checked for a good chute, then looked down for the first time. Between my boots, I saw the inferno that made up the three targets that we had hit over the last 20 minutes. As I watched, I saw a series of explosions walk through the target, another string of 27 bombs finding paydirt. Then, [just ahead on the ground] I caught another series of explosions—right in line with my drift. 'Oh, God, now what?' There shouldn't be another target over there; that was our escape route. As I looked down,

I realized that this fire was shaped like an arrow—our B-52 had plowed in flames into a village.

"Now panic was beginning to replace concern. Where were the #\$\$@& clouds that had covered the ground when I first bailed out? With the full moon I could see the ground clearly all around, and the white panels in the canopy and my white helmet were not going to be assets as I slowly descended to the ground no more than 10 kilometers north of Hanoi."

The North Vietnamese could see nothing through the heavy overcast, and it was several minutes before the Air Defense Command Headquarters received word that a B-52 had crashed on the outskirts of the city. A few minutes later calls began to come in about the capture of three B-52 crew members, including Bob Certain. Shortly after his capture, Certain was shown the body of his commander, Don Rissi, who had apparently died from wounds sustained during the SAM strike.

As the first raid moved away, the tension in the North Vietnamese command posts eased—they had absorbed the B-52 attack and had been able to strike back. Trucks from the missile battalions began to pick their ways through the muddy streets and burning buildings to warehouses where new missiles were waiting. Workers at the warehouses frantically assembled the missiles and loaded the finished weapons onto the trucks to carry back to the missile emplacements. Just before midnight, U.S. fighter and support aircraft once again appeared on the radar screens. Another B-52 strike was on its way.

On the ground in a Hanoi prison, Norb Gotner, one of the few U.S. air crewmen recovered from Laos and brought to North Vietnam, heard the air raid sirens, then the crackle of anti-aircraft fire and the roar of fighters in afterburner. He recently recalled that he "had been close to B-52s bombing in Laos, and recognized the first string when it went off. I remember commenting that the 'BUFFs [nickname for B-

52s] are here and that this would bring an end to this damn war.' There was no sound of incoming aircraft, and that made it more scary for the North Vietnamese. The deafening steady roar of the bomb string going off would roll down the streets and go through the cells. The concrete cells would sway back and forth as in an earthquake.

"We really didn't have windows (too big of a luxury) but we managed to cut away a small sliver of the wooded slats that covered the barred openings. It was like looking out of a keyhole. We could see the yard between cellblocks and a small piece of the night sky and we couldn't believe so many B-52s got shot down as we could see the hits and the flaming planes come down. The next morning the ground was covered with chaff."

*A poster in central Hanoi refers to the "Dien Bien Phu of the Air." Dien Bien Phu is the location of the battle that drove the French from Indochina.*



MARSHALL MICHEL



**T**he second wave of B-52s came in on the same route as the first, heading for many of the same targets. Peach 02, the second B-52 over a target that had been bombed by the first wave, dropped its bombs and immediately rolled into its post-target turn when it was hit by a missile. The pilot managed to drag the badly crippled bomber back to Thailand, where the crew bailed out safely.

Back at U-Tapao, Lieutenant Colonel John Yuill was leaving the third wave's briefing when the crews from the first wave came in. "They didn't say a word, but looking at their eyes I knew it must have been a bad day at the office," he said.

As the second wave withdrew to the south of the city, the commander of the 77th Battalion, Dinh The Van, discussed with his fire control officer, Nguyen Van Duc, how they might shoot down a B-52 using the automatic tracking function of the Fan Song guidance radar. While automatic tracking was very accurate, it was generally considered to be impossible to use when the target was jamming. One battalion commander later said, "No one dared think of [automatic tracking] when discussing the method of fighting the B-52s because it was too idealistic.... The three radar screens had been used automatically only in 1965 and '66...when there was no radar jamming and the enemy had not been so crafty."

Still, Van was determined to try. The first wave had almost ended Van's hopes when several bombs hit close to the 77th, damaging some of the equipment and causing casualties among the crews who loaded the missiles on the launchers. A few minutes later, when Van turned on his Fan Song and tried to automatically track a B-52, the site was attacked by a Wild Weasel whose Shrike exploded less than 100 feet from the command van.

Van's frustration mounted when the second wave of B-52s attacked and the battalion could not break out a bomber from the jamming, but during that attack Van thought he noticed a point when the B-52's jamming dropped off. "We saw that the B-52s heavily jammed and usually whitened our radarscope...[but] we saw that the jamming did not remain heavy all the time," he recalls. "The main point was to calculate and determine the timing [and] range to expose the B-52 for us to kill like a lamb."

Van and his crew had another opportunity four hours later when the third wave of B-52s arrived, flying the same



*B-52 wreckage drew a crowd in 1972. Commander Dinh The Van (right), who discovered how to exploit a U.S. tactical error that made the bombers vulnerable to tracking radars, stands before the B-52 parts and pieces stacked at the Hanoi museum.*



VIETNAM NEWS SERVICE

GEOFFREY CLIFFORD

route and bombing some of the same targets as the previous two waves. The crew members of the 77th watched their assigned target carefully, and when they saw its jamming decrease sharply, they fired two missiles and went to the automatic tracking mode. The B-52 Rose 01 was hit, and four of the crew members bailed out successfully before the B-52 crashed in the suburbs of Hanoi.

Van had discerned a major

vulnerability in the U.S. tactics. SAC had directed that each bomber roll into a steep post-target turn immediately after bomb release, a carryover from the days of high-altitude nuclear delivery. But SAC had not tested these tactics against the Fan Song radar or considered what a steep post-target turn would do in a SAM environment. In fact, the turn rotated the bombers' fixed and downward-focused jamming antennas away from the SAM radars on the ground, enabling the Fan Song radar to break out the aircraft's radar return and track it automatically.

The next morning, as the sun rose, curious Hanoi citizens surrounded the wreckage of two B-52s. Units from all over Vietnam sent congratulations, and General Nhan said that "a special feeling pervaded the various command headquarters, from the battalion to the general staff, from the northern rear area to southern battlefields. The Hanoi air defenses had stood up to America's greatest weapon and had held its own; it had inspired the people and the Army."

Although the bombers flew the same routes to the same targets with the same post-target turns the next night, the North Vietnamese hit only two and were unable to bring any of them down. The following morning the 361st Air Division staff called all of the missile battalion commanders to an urgent meeting at headquarters, disregarding the fact that they had not slept all night. Each of the nine battalion commanders was called before the assembled group to explain what tactics he had used, why they had failed, and what he planned to do to improve results. That afternoon, staff officers visited each battalion to review their tactics and procedures on the command van's simulator, and the crews practiced their operations in all the situations they had seen the first two nights and developed variations on their standard methods of controlling the missiles to take





*This now-declassified post-battle briefing map shows that a B-52 raid planned by the Eighth Air Force hit targets in Hanoi from all directions. The next day the North Vietnamese offered to resume peace negotiations.*

advantage of the B-52s' predictable maneuvers.

The third night of raids, December 20, began like the two previous nights: The first wave of B-52s appeared just before eight o'clock. As the U.S. force approached, the crew members in the command van of the 93rd Battalion waited anxiously. The 93rd had been harshly criticized for its failures the night before, and all that afternoon the officers had reviewed their procedures with a trainer from the 361st Headquarters staff. As the B-52s moved in to bomb targets they had bombed the previous two nights, the 93rd's hard work earlier that day was rewarded: The men fired two missiles at a B-52 banking in its post-target turn, and a few moments later Quilt 03 fell almost vertically out of the sky. Four of the six crew members survived.

The rest of the missile battalions soon made up for their failures of the previous night. Three battalions fired at one bomber, their missiles arriving just as the bomb doors on the aircraft opened. The resulting explosion was bright enough to be seen by a U.S. reconnaissance plane 80 miles away over the Gulf of Tonkin; miraculously, two of the six crew members survived.

As B-52 after B-52 was hit, the news flooded into the 361st headquarters command post, where a loudspeaker on the bunker's wall carried the voice of a female radio announcer reporting combat developments. Le Van Tri, commander of the Air Defense Command, called the 361st to report: "The enemy's formations are becoming disorganized. They are calling one another in panic and requesting air rescue...."

The North Vietnamese were ecstatic, but few missiles were coming over the assembly lines as they tried desperately to get ready for the expected midnight raid. Yet at mid-

night there was no raid on Hanoi, only a small B-52 raid well to the North. The second wave of B-52s scheduled to bomb Hanoi had been recalled by SAC. The North Vietnamese missile crews had done what the Japanese, Germans, North Koreans, Chinese, and Russians had failed to do—for the first and only time in the history of U.S. air combat operations, U.S. bombers on their way to a target turned back because of enemy defenses. Having decided to turn the second wave back, however, SAC reversed itself and sent the third wave on. By the time it arrived—about four in the morning—the Hanoi missile battalions had been rearmed.

Once again the North Vietnamese watched incredulously as the B-52s flew the same routes to attack the same targets they had bombed eight hours before. Almost immediately a B-52 was hit in its post-target turn, but the pilot was able to fly the damaged aircraft to Laos, where all but one of the crew bailed out. Two more were shot down in the next 15 minutes.

At the U.S. Air Force fighter bases in Thailand, there was a new opinion of B-52 crews. For years, fighter pilots, who flew at low altitudes over heavily defended territory, had ridiculed the bomber crews for flying so high over undefended areas and never suffering combat losses. During Linebacker II, U.S. airmen watched the B-52 crews fly through a hail of SAMs, lose their crewmates, and go back night after night. From then on, the comments impugning the courage of the bomber crews stopped.

When word of the losses arrived at the B-52 base at U-Tapao, the 17th Air Division commander, Brigadier General Glenn Sullivan, decided he had had enough. "I called the operational commanders, Colonel Don Davis and Colonel



Bill Brown, and told them to get a bunch of the experienced guys together as soon as they landed and give me some changes to go to SAC with," he recalls. "I was opposed to the single-file 'bomber stream' concept, every night at the same altitude, and the other dumb tactics. These guys came up with a bunch of smart changes and put them in a message. Early that morning I signed the message out directly to General J.C. Meyer, CINCSAC, and sent an information copy to my boss at Eighth Air Force, General Jerry Johnson. I wanted it to get to SAC right away. Some of the people were afraid I would get in trouble for sending it to Meyer directly, but we had to do something."

The message had some effect. After seeing Sullivan's recommendations, the B-52 commanders in Guam followed with a message supporting his suggestions. The next night the post-target turns were drastically altered, but SAC still insisted the bombers use the same routes and single-file tactics to the target, and two bombers were shot

down. Because of the losses, for the next three nights SAC directed raids on targets other than Hanoi. No raids were conducted on Christmas day. The night of the 26th, the B-52s went back to Hanoi, but the missions were planned by the Eighth Air Force using the ideas developed by General Sullivan and the combat crews.

It was about 10 o'clock on the night of December 26 when the North Vietnamese early warning radars detected the massing of escort forces that meant B-52s were on the way. The radar controllers watched a large B-52 raid moving up through Laos, but then another force of B-52s appeared coming in from the Gulf of Tonkin. The two B-52 raids bracketed the city and began to spread out around both Hanoi and Haiphong. Then, at almost the same time, over 110 B-52s turned inbound to their targets, attacking from all directions on the compass.

In 15 minutes it was over. The North Vietnamese controllers tried desperately to track the raids, but their manual system was overwhelmed as the B-52s swept in from different angles almost simultaneously. Additionally, instead of making their standard—and deadly—post-target turn, many of the B-52s continued straight ahead or delayed their turn until they were out of missile range. Missiles engaged most of the raids, but by the end of the attack only one B-52 had been shot down over Hanoi (another crashed at U-Tapao on landing). It was clear that the North Viet-



GEOFFREY CLIFFORD (2)



*Inside the B-52 museum, displays include the ejection seat from (now Senator) John McCain's A-4 and photographs of President Richard Nixon (left) and a B-52 in flight, above a quote from Henry Kissinger calling for increased bombing.*

slowly fell into place for me. The crux of the issue is that the United States and North Vietnamese leadership had different views of the purpose of the bombing campaign. For the United States, the Paris Peace Agreement fulfilled Nixon's aims—it brought the POWs home and enabled the nation to end its participation in the Vietnam War, with its credibility and its commitment to South Vietnam intact.

The Vietnamese, however, said the bombing had a different aim. They insist that the bombing was meant to force them to capitulate and to withdraw their troops from South Vietnam. Thus, when the Paris agreement allowed the North Vietnamese troops to stay in the south, they were able to claim that Linebacker II had "failed," a belief reinforced when the North Vietnamese troops that had stayed in the south led the final unification offensive in 1975. But to completely understand the difference in interpretation, I had to realize that, in the Vietnamese view, Linebacker II was simply another victory in a string of victories in a 30-year war of independence. The proof that the battle was a victory was the final unification of their country. —

*This article was adapted from Marshall Michel's forthcoming book, The Eleven Days of Christmas: America's Last Vietnam Battle, to be published by Encounter Books this spring.*

namese defenses could no longer expect to shoot down large numbers of B-52s, and the next day, December 27, North Vietnamese negotiators told their U.S. counterparts that they would be willing to resume negotiations in Paris.

There were details to be worked out, and the raids on Hanoi continued. The night that the North Vietnamese agreed to return to Paris, 60 B-52s went back to the capital and two B-52s were lost, and on the nights of December 28 and 29, the B-52s raided without loss. Then, on December 30, because enough progress had been made, President Nixon ordered a final bombing halt, and by the end of January, the Paris Peace Agreement ended the U.S. involvement in the Vietnam War.

Thereafter both sides agreed that Linebacker II had been the critical battle, the battle that had ended the war, but that is where agreement stopped.

After I talked with the some of the missile crews and other veterans, the Vietnamese picture of the Christmas bombing





According to French photographer Alain Ernoult, everyone knew when the magic moment came: As British driver Andy Green, a Royal Air Force fighter pilot by day, rocketed through the sound barrier aboard the twin-jet car Thrust SSC, the ground shook, the car's dust trail lifted off the ground, and people 50 miles away heard the boom. Thus the world's first supersonic automobile entered the record books on October 15, 1997, with a land speed record of 763.053 mph.

Ernoult, a Paris-based photographer of anything involving records and technology, documented the Thrust SSC team's progress leading up to that pivotal morning in Nevada's vast Black Rock Desert. Led by Richard Noble, also British, who had set a land speed record of 633.468 mph in 1983, the team prepared the car for several runs up and down the 30-mile track. (The rules call for reaching the speed twice, on two separate runs, within an hour.) Ernoult, meanwhile, placed cameras on the desert floor, in the car's vertical stabilizer, and in his own hands aboard an airplane flying along the track.

Spooling up the two Rolls-Royce engines (generating a total of 50,000 pounds of thrust), Green set off for his first run just after 9 a.m., accelerating from 300 to 500 mph in only 10 seconds. As the car broke through the sound barrier, the vibration erased tracks made by the solid aluminum wheels. Green reached 759.333 mph. On his return run, he bettered that by more than 7 mph. The average was Mach 1.02.









# Strategy and Vision

## Hap Arnold and the Evolution of American Air Power

by Dik Alan Daso. *Smithsonian Institution Press, 2000. 314 pp., \$29.95 (hardbound).*

Hap Arnold is a figure rather hard to warm to, and one that until now hasn't been blessed with a serious biography. Dik Daso, one of a handful of fighter pilots to earn a Ph.D. in history, fills the gap, and in the process uses Arnold's life as a metaphor for the development of U.S. air power in the first half of the 20th century.

As a West Point cadet, Arnold was indifferent in his studies, conduct, and athletics, excelling only as leader of a

hell-raising band of pranksters, the Black Hand. But he did learn one invaluable lesson at the Point: "how to work the system," as he put it later. Still, he was blackballed from his first love, the horse cavalry. As an infantry officer, Arnold became interested in aviation mostly because it offered him a way out of an unglamorous assignment.

Arnold was the second Army officer to earn wings, but he wasn't a great pilot. After a near-fatal stall, he lost his nerve and grounded himself for several years, thereby acquiring the experience in logistics and administration that would later serve him so well. He also missed World War I, though he did manage (literally in the war's last hours) to earn the decorations needed for his career.

He was a consummate politician, able to schmooze both presidents and factory

workers. He was a visionary, too, who in 1940 told his subordinates to "be bold" in estimating how many airplanes they'd need over the next several years. They wanted about 100. "To hell with you!" Arnold said, and asked the president for 100,000.

And he was a strategist, one who almost single-handedly built up the U.S. Army Air Forces and gave it a distinct mission: "breaking down the will of the [enemy] people." To achieve that power, Arnold was willing to sacrifice the AAF's near-term combat capabilities. In 1941, he spent \$42 million on the B-29, which didn't pay off until the war's final year. In the end, his vision was great enough to see beyond the juggernaut he'd created: "We must bear in mind that air power itself can become obsolete," he said.

Arnold retired when the war ended and died three years later, but he did see the creation of an independent U.S. Air Force, whose missiles were as important as its piloted aircraft.

—Before he caught the aviation bug, Daniel Ford wrote three novels on terrestrial topics, which were republished this year by iUniverse.com.

Two hellraisers: Hap Arnold (left) and Gregory "Pappy" Boyington (below).



NASM (2)



## Black Sheep One: The Life of Gregory "Pappy" Boyington

by Bruce Gamble. Presidio, 2000. 435 pp., \$29.95 (hardbound).

"Drunk or sober, he could fly rings around anybody." Thus does Bruce Gamble set the stage for his spellbinding biography of one of the most compelling pilots of World War II.

The Black Sheep's troubles began before he was born. His legal father was an abusive drunk, prompting his mother to run off with a friend who may also have been Boyington's biological parent, and who as a family man proved an even worse bargain. The boy grew up with the surname Hallenbeck in St. Maries, Idaho. It was a Huck Finn boyhood, of the sort to gladden a biographer's heart: fighting, climbing trees, crashing a soapbox "airplane," cadging a ride in a Curtiss Jenny, running away from home to attend an airshow in Spokane. Yet Boyington also showed promise as an artist, and he furthered the talent by studying architecture and aeronautical engineering at the University of Washington. (His fans will find it less surprising that he was also a varsity wrestler.)

By 1935 he was a Boeing draftsman earning \$100 a month, with which he supported his teenage wife and newborn son. Then he learned that his true name was Boyington, under which he promptly joined the U.S. Marines, proclaiming himself a bachelor (married men weren't eligible for flight training). A great pilot but a lousy Marine—in debt, in trouble, and a problem drinker like all three parents—he was allowed to resign in 1941 to join the American Volunteer Group, soon to win immortality as the Flying Tigers. As you might expect, Boyington came home from China with a mixed bag: two air-to-air victories and a dishonorable discharge from AVG commander Claire Chennault.

A Marine again, he reprised his role in the Flying Tigers with a squadron he called the Black Sheep, about which Gamble has written in an earlier book. God knows how many Japanese planes Boyington shot down—not the 26 he claimed, but enough to make him one of the leading U.S. fighter pilots of World War II. (And yes, he really did fly drunk.) He also earned the Congressional Medal of Honor and 18 months' captivity in some of Japan's foulest prisons.

Of all this, and of Boyington's problems with family, friends, and booze, Gamble writes with intelligence, skill, and affection. He has crafted a splendid

and important biography—a must-read for every military aviation buff.

—Daniel Ford wrote *Remains* (a novel about the *Flying Tigers*), one of whose characters resembles Greg Boyington.

## Leap of Faith

by Gordon Cooper with Bruce Henderson. HarperCollins, 2000. 411 pp., \$25.00 (hardbound).

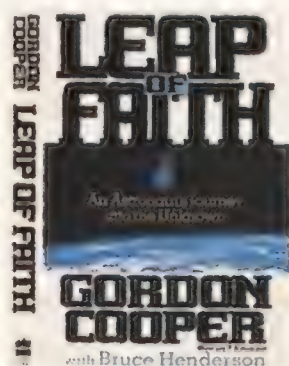
There are a few things one can say with confidence after completing Gordon Cooper's autobiographical tome *Leap of Faith*. One: Cooper was born in Shawnee, Oklahoma, in 1927. Two: His childhood included associations with aviation pioneers Amelia Earhart, Roscoe Turner, and Wiley Post. Three: After stints as a Marine rifleman and Air Force pilot, Cooper was selected for NASA's fledgling Mercury program and made two spaceflights. Beyond that, acceptance of just about every other statement in "Leap of Faith" requires the reader to make his own leap of faith.

Which is too bad. After all, Cooper is a hero of the golden age of space exploration. He volunteered to put himself on top of a rocket before anybody knew what the result would be. Who better to explain to the masses the

history of one of the most courageous endeavors in the annals of human discovery? Yet the book is filled with claims that seem intended to shock rather than explain. Among

them is the statement that pictures he took during Gemini V were personally confiscated by President Lyndon Johnson because they revealed details of the super-secret Area 51.

More shockers: The book reports that prior to its never-completed mission, the Apollo 1 command module was scheduled to go in for a refit that would have included a new, fast-opening hatch. Writes Cooper, "The new hatch, which Apollo 1 would have flown with, probably would have saved Gus, Ed and Roger" from the launch pad fire that killed them. That fellow Mercury astronauts Alan Shepard and Deke Slayton were working behind the scenes to torpedo Cooper's shot at a moon flight: "Putting a couple of frustrated astronauts—with a total flight time of fifteen minutes in space between them—in charge of crew assignments had been like placing a couple of hungry tomcats in charge of the aviary," writes Cooper.



## ON TV

### Inside the Space Station

Premieres Sunday, December 10, 9:00 p.m. EST on Discovery Channel.

An inside look at astronaut training in preparation for manning the International Space Station. Viewers can also follow the station's progress on [www.discovery.com](http://www.discovery.com), which will feature astronaut profiles, streaming video of interviews and space station news, and a tracking feature for locating the station in the night sky.



### Search for the Japanese Fleet

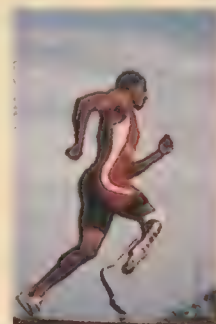
Premieres Wednesday, December 20, 9:00 p.m. EST on Discovery Channel.

Researchers from the U.S. Navy and other agencies are searching for the wrecks of Japanese aircraft carriers sunk during World War II's battle of Midway. Already found: the carrier *Kaga*.

### Space Medicine

Premieres Sunday, December 10, 10:00 p.m. EST on Discovery Health Channel.

A look at the medical breakthroughs pioneered in space by astronauts and on the ground by researchers.



### Air Rage

Premieres Sunday, December 17, 10:00 p.m. EST on The Learning Channel. When airline passengers attack—the alarming increase in in-flight violence.

That a medium who received inter-dimensional transmissions from an extraterrestrial higher intelligence may have prevented a potential dangerous problem with the space shuttle's cooling system. That very same higher intelligence later offered Cooper another ride in space—on an extraterrestrial spacecraft: "I loaded my camera, gathered my things, and waited—with the same anticipation that I'd waited for other space rides."

Pretty wild stuff. And at the very least, much of it outlandishly unconfirmable. But discounting reality seems to be a staple in *Leap of Faith*. Of course, this is the same book that states that the five-engine Saturn V booster sported eight engines. That Cooper was the first to



carry a TV camera into space. And that later, during Gemini V, he and Pete Conrad had been the first pilots in history to change orbits in space. All of these statements are easily verified and utterly false. Much of the book is made up of such outlandish, poorly constructed explanations and half-truths.

Near the end of *Leap of Faith* Cooper writes about the existence of extraterrestrials: "Must a UFO land at the Super Bowl to get the world's undivided attention?" Perhaps not for Gordo. But to make believable tales of UFOs stick, the storyteller's stories have to ring true.

—D.C. Agle is an author and pilot living in Playa del Rey, California.

## Challenge to Apollo: The Soviet Union and the Space Race, 1945–1974

by Asif A. Siddiqi. NASA History Division (to order: 202-512-1800; <http://bookstore.gpo.gov/index.html>), 2000. 1,011 pp., \$79.00.

This is an important book—the first NASA-published account of the Soviet Union's performance in the 1960s moon race and an essential context for the early U.S. space program.

Author Asif Siddiqi, a candidate for a Ph.D. in history at Carnegie-Mellon University, says NASA was pitted against a Soviet program in near-disarray. There was no single program head—no equivalent of NASA's James Webb. Instead, it was governed by the leaders of competing design bureaus, pathologically stubborn old men who fought and allied with each other to seize their share of scarce resources.

The Soviet leadership was by turns indifferent and capricious, backing first one bureau, then another. It did not commit fully to putting a cosmonaut on the moon until 1967—six years after President Kennedy's 1961 moon speech, which, Siddiqi reports, made little impression on the Soviets. The book is potentially controversial, for it brings to mind a hard question: How significant is the U.S. victory in the moon race if the Soviet Union was such a weak competitor?

*Challenge to Apollo* is built primarily on Russian sources published since 1990, but also contains information Siddiqi gleaned through interviews with the likes of Nikita Khrushchev's son Sergei and from recently declassified CIA files. The author sought to write both a reference book and a gripping story, and he combines these forms admirably (though

the book is under-indexed for its size, reducing its utility as a reference).

Given its daunting bulk and level of detail, it's tempting to call *Challenge to Apollo* a book only for space fanatics, but it has many features to please readers with a casual interest in space. For example, it contains exquisite personality profiles. Siddiqi published a book of poetry in his native Bangladesh, and his sensitive portrayals reflect this artistic talent. All the major and many minor characters in the Soviet story are economically and effectively sketched, even the canine cosmonauts.

Soviet space heroes come across as heroic, but also as victims. Siddiqi recounts that Yuri Gagarin, the first man in space, was grounded after his 1961 flight so he could be trotted out for state occasions, a duty that crushed his spirit. Valentina Tereshkova's frank account of the discomforts she experienced during her 1963 flight, in which she apparently performed no worse than any of her less forthcoming male colleagues, was used as an excuse for grounding Soviet women for 19 years. Some NASA

officials used Soviet accounts of Tereshkova's flight to justify rejecting women astronauts until 1978.

No space buff's library will be complete without this book. Readers



will marvel at the complex interactions between design bureaus, and will enjoy getting to know the people behind the failed Soviet effort—a vital step toward putting Apollo's victory in context.

—Arizona-based science writer David S.F. Portree formerly ran the history office at NASA's Johnson Space Center in Houston and has written numerous space history publications.

## Skippers of the Sky: The Early Years of Bush Flying

selected and edited by William J. Wheeler. Fifth House Ltd., 2000. 248 pp., \$22.95 (hardbound).

The editor of the Journal of the Canadian Aviation Historical Society has compiled a highly readable collection of 12 stories written by early bush pilots about their difficult yet exhilarating work in the vast, often unmapped Canadian wilderness. Because the pilots themselves set down

the reminiscences, these tales move along with a lightheartedness that belies the dangers the narrators faced. In their stories, they describe both their near-misses and the "exquisitely wild loveliness" with equal affection.

Their contributions were crucial to the development of Canada during the decades after World War I; the bush pilots reduced difficult overland journeys from weeks or months to a matter of hours. They ferried people and cargo, flew mapping and mineral surveys, fought fires, helped enforce fishing regulations and liquor laws, and conducted salmon counts. The variety of the cargo was staggering: packs of quarrelsome huskies, live beavers, mink, oxen, piglets, and fingerling fish (to release midair over lakes), human corpses both frozen and thawed, gold bricks and dressed furs, hazardous sulfur-rich ores and dynamite, disassembled bulldozers and trucks, diamond drills, canoes, and lumber strapped to the struts.

Conditions were incredibly harsh—summer brought swarms of mosquitoes and winter temperatures reached –70 degrees—and the aircraft had to be stripped of all nonessential equipment to keep maintenance and fuel needs to a minimum over long distances. Many bush pilots had no radio at all; the Royal Canadian Air Force relied on wicker baskets full of carrier pigeons. Pilots who made forced landings often had to camp for days before a rescue party arrived, or they improvised to replace parts; emergency gear included guns, rations for ten days, snowshoes, and sleeping bags.

Descriptions of the aircraft and flying conditions are riveting. One pilot used a "fast-flowing stretch of the river, about a half-mile in length, between two sets of rapids" to land his Noorduyn Norseman. Another had so little room to take off in his Gipsy Moth that he "tied the tail of the machine to a tree and, after reaching full rpm, had a helper cut the rope." Low-altitude surveyors had to hold their 16-ton Consolidated PB5-5As steady at 500 turbulent feet for hours at a time.

This engaging book features a chronology, a glossary, and a long list of suggested reading, in addition to excellent photos.

—Nan Chase, a Boone, North Carolina-based writer, wrote "Go for Launch!" for the Oct./Nov. 2000 issue.





## CREDITS

**"Aw, Hell, Television Is Here."** A past president of the Radio-Television News Directors Association, Harold Baker was the news and public affairs director at WFGA.

**The Light Brigade.** Walter S. Terry is a retired aerospace engineer and writer whose work has appeared in *The Best American Short Stories* series. He thanks James B. Hill Jr. for assisting with the article's technical details and for supplying the photograph, which was taken by Hubert Williams.

**Memories of Kosovo.** Captain Jonathan Knaul is a military helicopter pilot currently on active duty in Canada.

**Beat Up and Beautiful.** John Fleischman is a science writer at Harvard Medical School in Boston, Massachusetts.

**Test Drivers.** D.C. Agle, an author and pilot living in Playa del Rey, California, is currently hard at work on his next *Air & Space/Smithsonian* assignment, a feature about the Apollo lunar module.

Paul Bowen, a commercial photographer based in Wichita, Kansas, has been shooting aerial photographs since 1972.

Photographer Cameron Davidson can often be found strapped into the back seat of a Bell JetRanger with a bag full of Nikons.

**How to Get Along in Space.** Beth Dickey is an *Air & Space* contributing editor. She also

reports for *Newsweek* and CBS News Radio.

David Povilaitis has been drawing, cutting, scratching, and scanning bits of paper for visual effect in magazines and books for many years. He lives near the edge of wild and cultured things in Sonoma County.

**Soaring on Silk.** Tom Harpole, a frequent contributor, has become obsessed with cloud watching, to the detriment of safe driving.

Native Pacific Northwest aviation photographer Phil Schofield has survived two small-airplane crashes and 20 years of running his own business.

**Hang a Right at Jupiter.** Michael Milstein recently navigated his way from Wyoming to Oregon, where he covers the environment and science for *The Oregonian*.

**Home Grown.** Nan Chase is a freelance writer based in Boone, North Carolina. She rode the new Ozark Airlines to Columbia, Missouri, last August.

**The Christmas Bombing.** Marshall Michel is a retired U.S. Air Force colonel who flew RF-4Cs and F-4Es during the Vietnam War. His book *Clashes: Air Combat Over North Vietnam, 1965-1972* was published by the Naval Institute Press in 1997.

Geoffrey Clifford's images of Vietnam are being prepared by the Smithsonian Institution for a traveling exhibit beginning in 2001.



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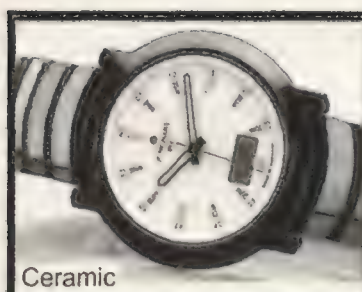


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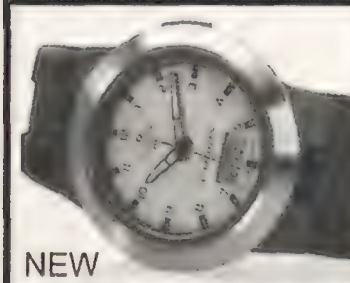


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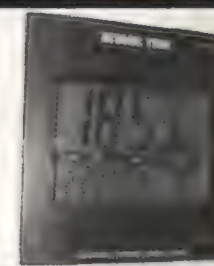
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## CALENDAR

### December 2

Fly-In Pancake Breakfast. Featuring a talk: "How to Cope with Cockpit Emergencies." EAA Chapter 690. Sport Aviation Complex at Briscoe Field, Lawrenceville, GA, (770) 613-9501.

Pearl Harbor Commemoration. This event features a seminar with veterans of World War II's Pacific battles and a flight demonstration of a Mitsubishi A6M5 Zero fighter. Planes of Fame Museum, World War II Cal-Aero Field, Chino, CA, (909) 597-3722, [www.planesoffame.org](http://www.planesoffame.org).

### December 12 & 13

Workshop to Explore See-and-Avoid Technologies and Operations for Unmanned Aerial Vehicles and Remotely Operated Aircraft in Civil Airspace. Double Tree Hotel, Crystal City, VA, (703) 264-7500, [www.aiaa.org](http://www.aiaa.org).

### December 21

Solstice occurs at 8:37 a.m. Eastern Standard Time, marking the beginning of winter in the Northern Hemisphere.\*

### January 1-February 8

"Flight Through the Quilt World." This exhibition features 31 framed quilt panels celebrating such classic aircraft as the Cessna Airmaster and the achievements of such aviators as Charles Lindbergh, Amelia Earhart, and Harriet Quimby. Tillamook Air Museum, Tillamook, OR, (503) 842-1130, [www.tillamookair.com](http://www.tillamookair.com).

### January 6

Test Pilots Seminar. Featuring a flight demonstration of a Northrop N9M-B flying wing, which underwent a 13-year restoration that was completed in 1994. Planes of Fame Museum, World War II Cal-Aero Field, Chino, CA, (909) 597-3722, [www.planesoffame.org](http://www.planesoffame.org).

\*Call the National Air and Space Museum's Skywatcher's Report at (202) 357-2000 for recorded information about astronomical events.

Organizations wishing to have events published in Calendar should submit them four months in advance to Calendar, Air & Space/Smithsonian, 901 D St. SW, 10th Floor, Washington DC 20024; fax (202) 287-3163. Events will be listed as space allows.

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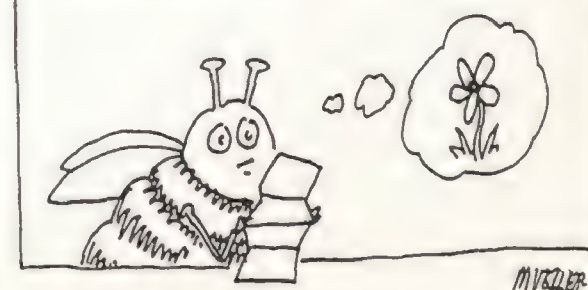
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### Closet Treasures

More unrestored aircraft than we could show you in this issue are hidden away in the National Air and Space Museum's storage facility; among them, the B-17 bomber *Swoose* (right) once modified to transport passengers. Visit our Web site to see more airplanes (dents and all) that will someday be displayed at the Museum's Steven F. Udvar-Hazy Center.



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## FORECAST



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### In the Wings...

#### Grand Theft, Aero

In June 1945, Soviet aircraft designer Andrei Tupolev received a direct order from Joseph Stalin to copy, rivet for rivet, a Boeing B-29, *Ramp Tramp*, that a U.S. crew had flown to an emergency landing in Vladivostok. A National Air and Space Museum curator tells the story of the engineers who transformed the B-29 into the Tu-4, the Soviet Union's first strategic bomber.

*B-29 knockoff: The first of a thousand Tu-4 strategic bombers to be produced in the Soviet Union was rolled out in 1947. Below: The Swiss air force has been flying F/A-18s since 1987. Yodelaheehoooo!*



© SCHWEIZER LUFTWAFFE

### Also...

#### What Were They Thinking?

Aircraft that were the contemporaries of the Wright *Flyer* look daft to us now, but there were aerodynamic methods to their madness.

#### Pictures of Home

Is Earth changing? Pictures don't lie, and early images from Terra, the first spacecraft in NASA's Earth Observing System, show some changes that may surprise you.

#### A New Fortress Mentality

A model of defensive preparedness, the Swiss air force flies Northrop F-5 Tigers, French Dassault Mirages, and now Boeing F/A-18 Hornets. And yes, they keep them in secret mountain caverns.

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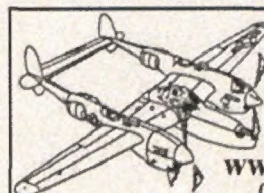
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## And They're Off!

**T**he demonstrator/concept vehicles for the next U.S. strike fighter made their first flights last fall when Boeing and Lockheed Martin began test flight programs in California for the X-32 and X-35A Joint Strike Fighters. Boeing's JSF chief test pilot Fred Knox

conventional takeoff and landing aircraft that will replace the F-16 and A-10 and complement the F-22A Raptor. The Navy wants a carrier-based strike fighter to complement the F/A-18E/F and replace the A-6, which has already left the inventory. The

Marines want a short takeoff and vertical landing fighter to replace the AV-8B Harrier and F/A-18 Hornet.

The vehicles that made their first flights were not prototypes of the aircraft the companies propose to build. Boeing calls its version a concept vehicle, while Lockheed Martin refers to its aircraft as a demonstrator. Several versions of the competing vehicles will be built: Boeing's X-32A will test conventional takeoff and landing design for the Air Force and carrier approach qualities for the Navy.

An X-32B, slated to fly in early 2001, will test

short takeoff and vertical landing capability. Lockheed Martin's X-35A is also a conventional takeoff and landing demonstrator; its C model will test carrier qualities, and the modified A model will be redesignated X-35B and will test STOVL performance.

The Department of Defense will select a design in 2001.

—Charles Spence

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BOEING

DENNY LOMBARD/LOCKHEED MARTIN

*The Boeing X-32A (top) and Lockheed Martin X-35A (above) are competing to be the next U.S. strike fighter.*

flew the X-32A on a 20-minute run from Palmdale to Edwards Air Force Base on September 18; Lockheed Martin's Tom Morganfeld flew the X-35 on the same route on October 24.

The two manufacturers are competing to build a strike fighter that can be used jointly by the Air Force, Navy, and Marine Corps. The winning design is expected to serve the three services as a fighter that can meet the needs of each while reducing costs of manufacture and maintenance by using structures and components common to all versions. Both companies claim their JSF will have roughly 80 percent commonality of airframe and avionics.

The Air Force version will be a

## LOGBOOK

### Awards

Herbert D. Kelleher, president of Southwest Airlines, will receive the Wright Brothers Memorial Trophy for significant contributions to U.S. aviation in recognition of his creating and molding an airline into a model for low fares, innovative customer service, and employee recognition that has changed commercial aviation worldwide. The Wright Trophy, considered aviation's most prestigious citation, is awarded annually in Washington, D.C., at a December dinner sponsored by the Aero Club of Washington and the National Aeronautic Association.

### Competitions

Germany won the 44th James Gordon Bennett gas balloon distance race last September, represented by Wilhelm Eimers and Bernd Landsmann, who flew 494 miles. The Americans Richard Abruzzo and Carol Rymer Davis placed second with 463 miles, and the Netherlands' Rien Jurg and Ron Van Houten came in third with 387 miles. The 2000 international Gordon Bennett race, the object of which is to fly as far as possible without touching down, started in St-Hubert, Belgium.

### Events

Air Sport Expo, featuring sailplanes, hang gliders, ultralights, aerobatic aircraft, and models, will be held at the Indiana Convention Center, Indianapolis, February 7 through 10.

### Call for Nominations

Nominations for the Frank G. Brewer Trophy for contributions of enduring value to U.S. aerospace education by an individual, a group, or an organization are due by December 31, 2000. Nominations for the Robert J. Collier Award for the greatest achievement in U.S. aeronautics or astronautics in the past year are due by January 31, 2001. For additional information, contact Ann Ruebelmann at the NAA: (703) 351-2462 or [aruebelmann@naa-usa.org](mailto:aruebelmann@naa-usa.org).



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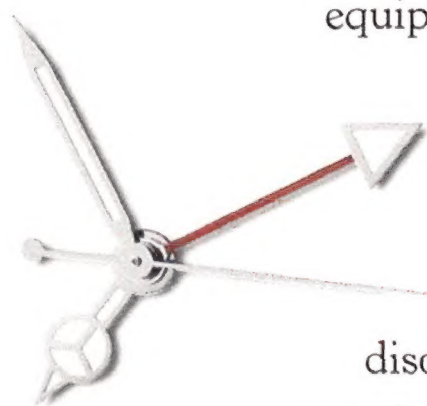
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